THE AEROPLANE

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Aeronautical Engineering
Edited by - - THURSTAN JAMES

Founder and First Editor
(1911-1939), C. G. GREY

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WHEN IS IT TO BE US?

NOBODY who was in London at the time is likely to forget the effect made by the arrival of the first V.2 rockets. If we remember rightly, one landed in Chiswick and the next in Smithfield Market close to Farringdon Road station. But in spite of the effectiveness of this German long-range weapon, the ensuing successful progress of the War resulted in the World's first long-range rockets being regarded as a nightmare to be forgotten rather than a prototype of devices which within 14 years were to be successfully launching man-made satellites from the Earth. The somewhat self-conscious hush which surrounds our own guided missile developments makes it all too likely that in official quarters we were very slow indeed in getting off the mark. Our own contributions to rocketry in the I.G.Y. programme are notably modest.

But before discussing our situation further we must add our meed of praise to the achievement of the U.S. Army team which within so short a period has launched a satellite flying highest and furthest. It is a tremendous achievement for Wernher von Braun who from his youth has devoted his genius to the perfection of rockets.

The first lesson to be drawn from this remarkable achievement is that it is no brilliant tour de force but another step in a well-defined programme. Von Braun makes no secret of his compelling ambition to reach first the Moon and then Mars. In this country it is still scarcely decent for any respectable engineer to take interplanetary travel seriously. It was regarded as a decisive step indeed when certain bold spirits in the Royal Aeronautical Society joined forces with the British Interplanetary Society for a symposium at Cranfield last year. And that was nearly 14 years after the Germans had begun to bombard the Southern half of England with guided missiles.

Last Sunday night Mr. A. V. Cleaver, a brilliant young engineer formerly with the D.H. Engine Company and now with Rolls-Royce, was interviewed by the B.B.C. on the U.S. achievement. Mr. Cleaver, by the way, has been a member of the British Interplanetary Society for many years and no doubt it was in such capacity and as a private individual rather than as a member of any constituent part of the British aircraft industry that he was interviewed. His reactions were quite simple and direct. In his view achievement in launching a satellite depends entirely upon the support which is forthcoming from the Government. He gave it as a fact that von Braun could have launched the U.S. satellite a year ago if he had been given the job. What Mr. Cleaver did not say, and there is little enough time to say anything in a B.B.C. interview, was that the German Army began their support of von Braun in the early '30s, so it has taken 25 years of effort to reach the present stage. It is worth emphasizing the point here that British work on making thermonuclear fusion into a controlled process began in 1947 whereas work in the United States did not begin till 1951, which explains the superior position of Zeta and Sceptre.

Now the question which will be asked of our planners in the appropriate ministries is when did this country begin to work on interplanetary flight seriously. It was back in 1944 that Sir Frederick Handley Page gave the editor of THE AEROPLANE, at that time a civil servant occupied with military production duties, a discourse on the possibilities of interplanetary travel.

It is a fact and probably not without significance that both in Germany and the United States the most successful rocket work has been done by the Army. For understandable reasons Air Forces are constrained by their experience to concern themselves chiefly with the atmosphere. However, in a most interesting talk given before the Old Centralians luncheon club in London as long ago as December 13 Air Chief Marshal Sir John Baker, now retired, said:—

> "The hall-mark of the air today is supersonic manned flight; tomorrow it will be satellite manned flight. The conquest of the air can never be a static business. If we cannot continue to advance with the state of the art, we must accept a progressive decline and eventual elimination as a major power and partner in the aircraft field.
>
> "I believe that a Government policy decision that we should, as a matter of vital self-interest, remain a dominant Air Power would have a dynamic and revitalizing influence on the country as a whole. As the result, a truly national support for our aircraft progress and potential could emerge which would far better ensure our security, as well as our political and economic future than building 'Maginot lines' of guided missiles in this air age."

Does anybody really suppose that this country's place in the sky is going to be allowed to go by default? The White Paper on Defence has forecast the end of manned aircraft for offensive and defensive purposes, their place being taken by rockets, some of which we are allowed to understand will be imported. Has it already been decided by our planners that no attempt is to be made by British engineers and scientists to develop interplanetary travel? Are our close relatives in Australia, Canada and New Zealand content that this should be so? We do not believe it for a minute. And we expect to see soon any number of forward-looking Members of Parliament asking awkward questions in Parliament about British Interplanetary plans.

MATTERS OF MOMENT

New Shaft-turbine Agreement

AN AGREEMENT has been signed between the de Havilland Engine Company and the General Electric Co. of America whereby the G.E. T58 1,000-s.h.p. shaft-turbine engine is to be manufactured under licence by the British company. This arrangement is, in fact, an extension of the long-standing agreement on the interchange of technical information which has been in operation between the two companies since 1951. The T58 engine concerned was described in some detail in THE AEROPLANE for January 10.

The statement issued by de Havillands points out that this latest step is the outcome of a very close technical exchange and covers many aspects of gas-turbine design and manufacture. It is, moreover, "particularly gratifying to both parties and is likely to lead to further collaboration between the two companies." The American version of the engine, the statement goes on, is to be used by the United States Navy primarily in helicopters—including the development of the Sikorsky S-58 which is also manufactured in England under licence by Westland Aircraft, Ltd., as the Wessex.

Delivering more than 1,000 s.h.p. and weighing, with its gearbox, only 325 lb., the T58 has been described as being the most powerful shaft-turbine engine in the World for its weight and size. It has already accumulated an impressive background of bench and flight testing and passed its official government type approval test in America in October, 1957. Initially, the new engine is to be known as the de Havilland Gnome. It will be used as an engine for helicopters, but later versions will cover turboprop installations.

Air Planning in Parliament

IN the course of the debate on January 27 last in the House on the accounts of the Airline Corporations, Sir Arthur Vere Harvey (Cons., Macclesfield) asked the Minister to consider setting up an air policy tribunal, a body of men quite independent of the industry. He suggested that it should be composed of men such as Lord Hives, now retired, who had got to the top the hard way. Somebody like him as chairman, if he would serve, could do a tremendous job for the country. In America the Findletter Commission had done great work in this respect.

Sir Arthur said that such a body could inquire into the Corporations, the independent airlines and Fighting Services, and into any branch of the industry and advise the Government. In view of the changes in Ministerial appointments, it is necessary that some such body should be in being.

He emphasized that this country is not lagging behind at the moment. It undoubtedly leads the World in engines, although the lead has been shortened in recent years. In the Britannia, he said, we had what the Americans had not got. We have the best airliner in the World. We have also some remarkable heavy bombers. We must maintain this lead.

"Our whole economy revolves round the country putting its efforts and brains in such things as nuclear energy, about which we heard such good news last week, and the aircraft industry," Sir Arthur continued. "The only way to success is to spend money in the early days on research and development. We shall never reap dividends unless we do that. I urge my Right Hon. Friend to do these things for all he is worth, to see that the money is wisely spent and to ensure that clear-cut guidance on policy is given to the industry and to the airlines. If those things are done, we shall hold our own."

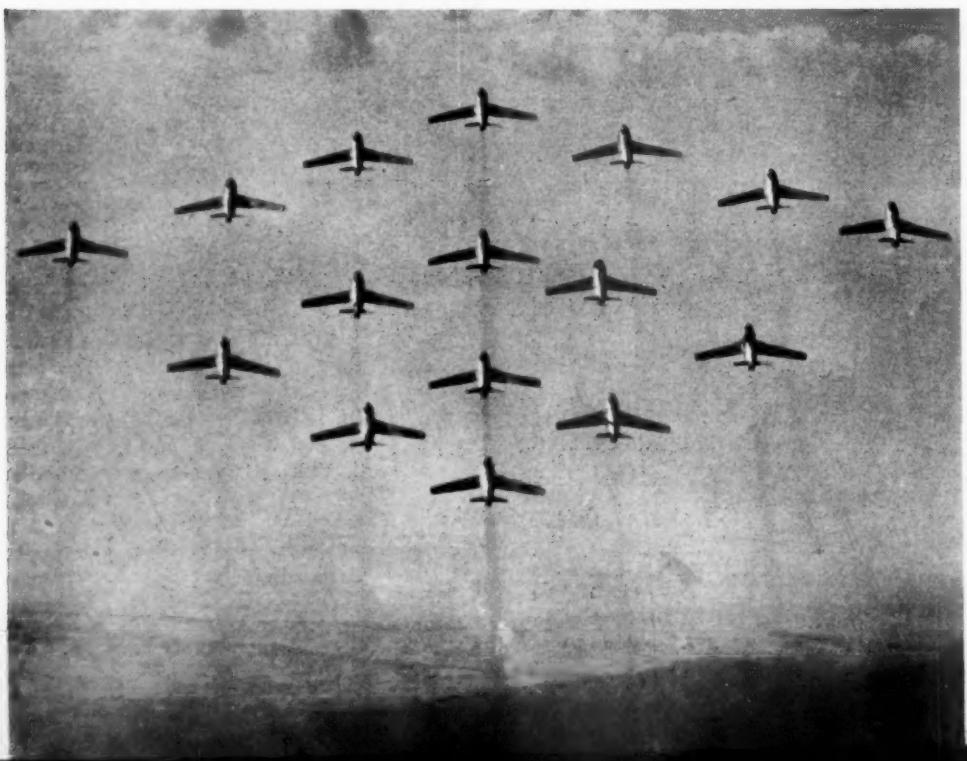
How satisfactory to know that the need for an Air Planning Authority to ensure the provision of clear-cut guidance on civil air policy is now being urged in the House of Commons. It is always later than one thinks. Plans for the next 10 years' research and development must be set out now.

Airco—The de Havilland Plan

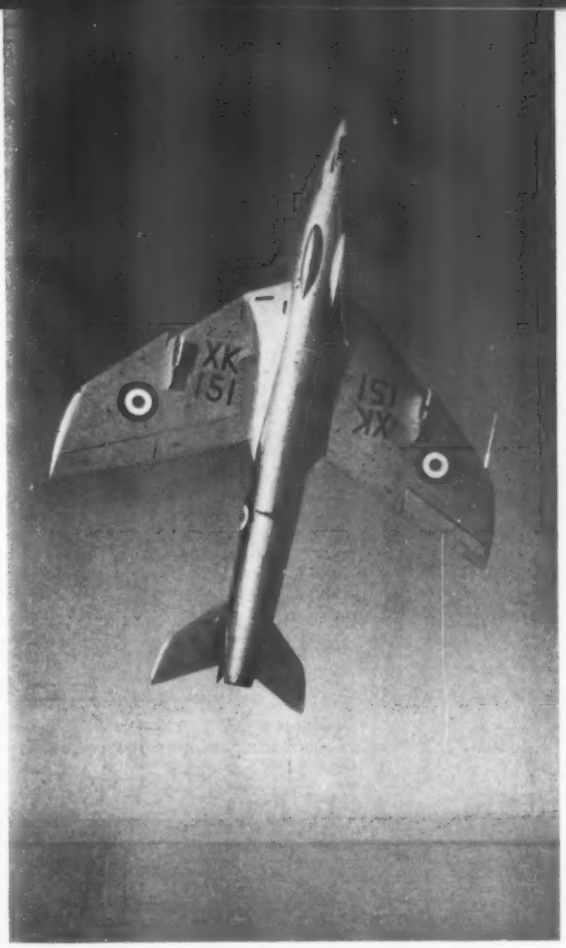
MORE details were announced last week of the arrangements which de Havilland have made to finance development and production of the D.H.121 short-haul jet transport, if it is ordered. A new company would be formed, called the Aircraft Manufacturing Co., Ltd., or Airco for short. This is the name of the company which was formed before the 1914-18 War to develop aircraft designed by Mr. (now Sir) Geoffrey de Havilland, and its resurrection now is not inappropriate.

Participation in Airco would be 67½% by de Havilland, 22½% by Hunting Aircraft and 10% by The Fairey Aviation Co., with respectively four, two and one directors on the board. Through the Hunting company, Airco would enjoy the support of the wealthy Hunting private shipping interests, and Rolls-Royce have also indicated that the venture would receive their support, to the extent of development of the engines and power-plant installations as a private venture. Similar support would be forthcoming from other leading specialist suppliers.

The details of Airco do not make clear just how the work



CLOSE SIXTEEN.—Pakistan held its "Air Day" on February 2 and John Fricker of THE AEROPLANE, who was in Karachi for the occasion, reported that the King of Afghanistan as well as the Chiefs of Staff of the Iraq, Iran and Turkish Air Forces were to be there. A great feature of the Show was to be a loop in formation by 16 Sabres of the Pakistan Air Force. Excellent station-keeping by the pilots is shown in this photograph.



HAWKER SUCCESS.—A Hunter 6 with saw-tooth leading edge, of the type recently ordered for the Swiss Air Force. A contract worth £13m. for 100 of these aircraft has been signed between the Swiss Government and Hawkers.

would be divided between the three companies. Project design work on the D.H.121—an illustration of which appears on page 166—has been the sole responsibility of the de Havilland design team and overall control of the design would presumably remain with the company's technical director, Mr. R. E. Bishop, and the chief designer, Mr. C. T. Wilkins.

Successful Selling

WELL KNOWN in the aviation world for more than 26 years, the aircraft-selling firm of W. S. Shackleton, Ltd., has recently sold its first helicopter—a Bristol 171 Sycamore. It has been bought by Williamson Diamonds, Ltd., and after renewal of its C. of A. at Bristols and, registered VR-TBS, was flown out in a Bristol Freighter to the diamond mines at Mwadui in Tanganyika. The Freighter, incidentally, is being offered for sale on behalf of M. Boussac, the French race-horse owner.

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Lord Brabazon's Birthday

TOMORROW, February 8, Lord Brabazon of Tara will be 74. The aviation world joins its friends in the motoring, sporting, industrial and political worlds in expressing its regard and in wishing him many more happy and active years.

For fifty years "Brab" has nurtured and inspired British aviation and has been its ambassador abroad; pioneer, Parliamentarian, a man of committees and action; president of the R.Ae.C.; chairman of A.R.B.; past president of the R.Ae.S. and F.A.I.

Last autumn, when he lay sick and impatient in bed, he bet a golfing friend that he, Brab, would be on course again before Christmas. And, by heaven, he was. More recently, after a Saturday round, he motored home so enthusiastically that his younger, and beaten, opponent trailed him with difficulty. After lunch, they "played the horses" with the help of television and telephone; then a game of chess. Shortly after, Brab flew to Ireland.

The Satellites of Jupiter

A SIGH of relief went up in the United States when it was heard that the U.S. Army's "Jupiter-C" missile had restored American prestige by launching a satellite weighing 30 lb. into orbit round the earth. Major-General John Medaris, chief of the Army's ballistic missile centre, and ex-German V.2 designer Wernher von Braun are the heroes of the hour. The U.S. age of space has been announced, as of January 31, 1958.

At the time this goes to print, wildly conflicting reports as to the technical details of Jupiter-C are circulating, and it would be unwise to place too much reliance on any of them until they are officially confirmed. As the Jupiter missile is shrouded by military security this is to be expected. At a hastily called Press conference, von Braun stated that the basic structure of the liquid-fuel first stage had been lengthened to accommodate extra tankage so as to permit an increased burning time of 145 seconds prior to second-stage separation. The initial thrust has also been reported as only 78,000 lb., which is in marked contrast to the 135,000-160,000 lb. thrust claimed for the gimbal-mounted Rocketdyne S-3 motor.

Even greater silence surrounds details of the second stage, which is believed to contain the guidance system and a cluster of four solid-propellent Recruits (scaled-down Sergeants). Any resemblance between the second stages of Jupiter and Vanguard must be inferred, however, for no details have been released. On the other hand, the first photographs of the launching show the satellite perched above Jupiter's nose cone, surrounded by what appears to be a further cluster of small rockets. This third stage is reported to have been set revolving a few seconds before the end of the count down. Presumably this was to give the cluster directional stability after separation, whilst diagrams of the satellite itself indicate that it was itself part of a fourth-stage solid propellent rocket.

"Explorer," the name given to the Jupiter satellite, or "1958 Alpha" as it will be known in astronomical circles, contains a low-power and a high-power transmitter, both operating on 108 megacycles, approximately. The instrumentation is basically similar to equipment already designed for the Vanguard satellite. Minitrack receiving stations, already sited at strategic points around the World, will be able to pick up its signals, measure its speed and altitude, and take down stored data after triggering its high-power transmitter by a ground command signal. If the batteries continue to function for two or three months on low power, Explorer will have a far more useful life than either of the two Sputniks.

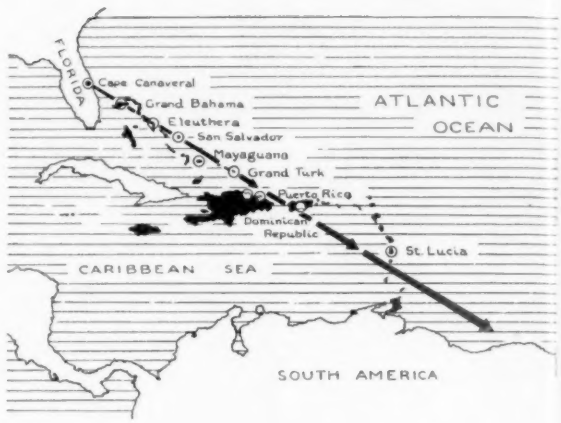
First guesses as to the life expectation of Explorer are likely to be as wildly improbable as those offered for the first Sputnik. Anything from three months to 10 years has been suggested. As its orbit is more elliptical than that of Sputnik II, and its weight is considerably less, its life should be shorter than that of the Russian satellite.

From a viewpoint of usefulness, the highly eccentric orbit is valuable because it enables data to be collected from much farther out into space. But once the batteries have run down its value is limited and more could be learned by a quick re-entry. Interest will then centre on whether the ceramic nose cone will preserve the instruments. It was a Jupiter-C's ceramic nose cone that re-entered the atmosphere at

12,000 m.p.h. without burning up, and was later recovered from the Atlantic Ocean close to the target.

Meanwhile, 1958 Alpha and 1957 Beta are now circling the Earth on orbits roughly normal to each other. Explorer was launched from Cape Canaveral south-eastwards along the track of the Florida Missile Range at 35° to the Equator, whereas Sputnik II started north-east at 63.4°. The perigee and apogee of the new satellite have been reported as 200 miles and 1,700 miles, whereas the Soviet satellite ranged from 140 miles to 1,017 miles in early November, though by now its apogee has shrunk. No one seems to be worrying about the possibility of a collision.

Despite the shortness of the first Sputnik transmission period a remarkable amount of information as to atmospheric density and upper air ionization, was deduced and published in various scientific journals by English and American observers. The air density at an altitude of 140 miles turned out to be five times denser than had been expected. It was even found out that Sputnik I was slowly revolving axially about once every 7-10 sec., and that its trailing aerials were endowing it with some kind of directional stability. Preliminary data have now been received from the Soviet Union which will enable much of this information to be verified.—I. G. WHY.



The U.S. satellite was launched down the Florida Missile Test Range.

Germany's Turbulent Pioneer

DOCTOR ERNST HEINKEL, who celebrated his 70th birthday on January 24, died in a Stuttgart hospital on January 30. He built his own aircraft in 1910, after four years at the Stuttgart Institute of Technology. A crash in this aircraft nearly ended his career but, recovering from multiple injuries, he served with the L.V.G., Albatros, and Brandenburg concerns and produced a wide variety of successful aircraft for the German Navy, and the Austrian Army and Navy.

That was between 1911 and 1918. In 1921 he was a director of the Caspar aircraft plant at Travemünde, on the Baltic, and in the following year he founded the Ernst Heinkel Flugzeugwerke at Warnemünde. From then until 1945, when, with the defeat of Germany in the Second World War production ceased, he designed and built about a hundred different types, including the He 178, which on August 27, 1939, was the first jet-propelled aircraft to fly.

To most people in the United Kingdom the name of the late Ernst Heinkel brings to mind his He 111 bomber, under which so many of us suffered. But to the engineer it was his He 70 and his pioneer work on jets which really mattered.

The He 111 was by no means his best aeroplane, but was the most built (6,450 manufactured) and appeared in many forms from about 1936 to 1944. But it would never have appeared at all if it had not been for the He 70 "Blitz" (Lightning) built in 1932. And that beautiful, clean, single-engined transport which was a real aerodynamic milestone, would not have appeared if Heinkel had not visited Venice in 1927 and become captivated by the Supermarine and Gloster Schneider Trophy seaplanes. "In Venice face to face with these beautiful fast machines, I was seized with an uncontrollable desire to build similar ones myself," he writes.

But it was not until 1930 that Heinkel was able to do anything about it. Until that time Heinkel had made plenty of money as a builder of prototypes and seller of licences, mainly on a long series of low-wing reconnaissance seaplanes of rather ungainly shape. Heinkel himself, although a trained engineer who built his first aeroplane in 1910, was not technically equipped to turn his high-speed ideas into aeroplanes.

The twin brothers Siegfried and Walther Günter designed in the late 1920s a beautifully streamlined light aeroplane for Bäumer-Aero in Hamburg. Paul Bäumer was a prominent aerobatic and former war pilot and in 1927, according to Kurt Tank (Focke-Wulf) he killed himself by spinning-in in the Rohrbach Rofix monoplane fighter after a party the night before. So Heinkel, deeply impressed by the Bäumer Sausewind, found it easy to pick up the two brothers. Thereafter the whole design outlook of Heinkel aircraft changed. One only needs to compare the Europa Rundflug He 64 and the larger He 70 with the Bäumer Sausewind (*Janes All the World's Aircraft*, 1929) to see they were all by the same designers. The break with the squared-off He 59 and He 60 was clear-cut.

In the He 70 the finish was so much better than that achieved by the Supermarine S-5 or S-6 that the present writer, then at Supermarine, wrote to Heinkel asking whether the He 70 appearing in the Paris Show had a metal or plywood fuselage. Never before had it been impossible to detect the presence of rivet heads by close examination. And not often since.

The He 70 was so outstanding that Rolls-Royce bought one so that they could demonstrate their Kestrel V engine to the best advantage, and at Supermarine we used the He 70 as an aerodynamic target when calculating the Spitfire performance.

The immediate purpose of the He 70 was to outdo the Lockheed Orion in service with Swissair and therefore competitive with Lufthansa. The He 70 outdid the Orion with brilliance and style. Instead of using bulky root fairings, the wing root was entirely reshaped and curved at the fuselage junction to minimize interference.

Out of the He 70 grew the He 111 ten-passenger twin-engined transport which had a similar elliptical wing with inswept roots. Later the planform was simplified to a straight taper in most of the production military versions.

Heinkel's sharp nose for the right man was also demonstrated by his recognition of the genius of von Ohain who developed the Heinkel series of jet engines independently of Whittle. This development has already been reported in THE AEROPLANE.

It is obvious from Heinkel's autobiography, ably ghosted by Jürgen Thorwald, that he was a ruthless driver of men and not above libelling former colleagues (such as Hertel) when they left him. He was of a highly independent nature and was at pains in his book to point out his consistent opposition to Nazism.

From his book one gains the impression that any opposition of any kind was anathema to him. His book shows that he was practically always right and that his failures were mainly due to others or to unrealistic technical requirements.

His complete failure with his four-engined He 177 bomber is dealt with in some detail. The main reasons appear to be undeveloped powerplants and the Luftwaffe requirement to make it into a dive-bomber.

There is no doubt that Heinkel must have been widely disliked, but at the same time he was recognized as an essential part of the development of the Luftwaffe. Heinkel did suffer because of his remarkably Jewish features, which he points out were Swabian and not Jewish. He was often insulted in public and in the Press. He also suffered from bureaucracy to the extent that several times he had to develop aircraft with his own money without even telling his Air Ministry, in order to get the work done at all. He believed in what he was doing and there is no doubt in the writer's mind that Heinkel did more than any other to keep the Luftwaffe up to date. But he was well ahead of them, and apparently kept on telling them so.

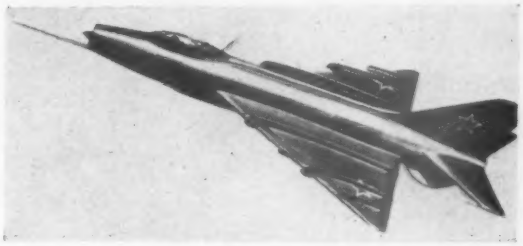
This short note cannot do justice to Heinkel's work and other activities. His book "Stürmisches Leben" (Turbulent Life) has been translated with certain libels removed and a few errors added such as "He-1000" (Hutchison), and is well worth reading.—B. S. SHENSTONE.

NEWS OF AIRCRAFT, ENGINES AND MISSILES

EXPLORER AWAY.—America's Earth satellite vehicle, the Explorer, was fired from Cape Canaveral, Florida, on January 31. The principal unit in this multi-stage rocket was a U.S. Army Jupiter C rocket.

GNAT FLY-OVER.—The second Gnat Mk. I built by Folland for the Government of India—which was airlifted by I.A.F. Packets from Chilbolton on January 18-19 (THE AEROPLANE for January 24) took part in the Independence Day celebration fly-past over Delhi on January 26.

VAUTOURS FOR ISRAEL.—Reports from Paris state that a number of Sud-Aviation Vautours are to be handed over to Israel. For some time Israeli pilots have been training at Tours, where Vautours of the 30th All-Weather Fighter Squadron are based.



FISH-FACE.—According to this U.S. Navy photograph, the Russian Fishbed B (one of the three Sukhoi designs) has three boundary-layer fences above and a stores mounting below each wing. The under fin is a new feature and may denote earlier directional instability at high speeds.

NO ORION.—Development of the Bristol Orion turboprop engine has been stopped. The Ministry of Supply has informed Bristol Aero-Engines, Ltd., that in the "present financial circumstances" support for development of the Orion is to be discontinued, although the M.o.S. remains "fully convinced" of the intrinsic merits of the engine.

THE RUSSIAN VTOL.—Russian sources indicate that the Turbolot "flying bedstead" (illustrated in our issue of October 25, 1957) was designed by a team consisting of Rafaelianc, Kwashinin and Lipshyn and under the leadership of Prof. Matvieyev. It has a cockpit similar to that of the MiG-17 fighter. Several modifications have been made to the prototype, which is being tested at Yuriy Garnayev. It is understood that many Russian designers are now engaged on VTOL aircraft, including jet airliners.

NEW NORD.—The prototype of the Nord 3400 army observation aeroplane was flown on January 20, piloted by J. Turcat.

CZECH PRODUCTION.—The Meta Sokol 3-4-seat all-metal low-wing monoplane is in production in Czechoslovakia. Powered by a 105-h.p. Walter Minor III engine, it has a range of 620-745 miles for a fuel consumption of 22-24 gal. An illustration of this aircraft appeared in THE AEROPLANE of May 24, 1957.

FRENCH REFUELLING.—First air-refuelling of a turbojet-powered aeroplane in France took place recently at Istres with a Sud-Aviation Vautour piloted by Jean Dabos. The Vautour was refuelled from a Canberra of Flight Refuelling, Ltd.

REGULUS II ORDERS.—An order worth about $26 million for continued production of the Regulus II submarine-launched missile has been placed with Chance Vought Aircraft by the U.S. Navy. There is a further contract for $7,500,000 for spares and special support equipment for this weapon, which has a nuclear warhead and M = 2.0 performance.

SPUTNIKS IN BRUSSELS.—It is reported that the original projects for the Russian sputniks are to be displayed at the forthcoming Brussels Universal International Exhibition.

POLISH AMBULANCES.—The Polish Air Ambulance Service received four new aircraft—two Aero 45s and two L.60 Brigadyrs—on January 4. They were flown from Prague to Goclaw aerodrome.

WHAT'S IN A GNOME?

CHOICE of the Gnome as the de Havilland name for the British-built versions of the new General Electric T58 shaft-turbine engine suggests several possibilities. We may hear in future of the Snowhite Elephant and its Seven Gnomes (no, not the B.E.A. jet-liner); of having Gnomes at the bottom of the Hat-field; of there being no place like Gnome for a shaft turbine; and may be adumbrated by flocks of clay gas-turbine replicas cluttering up the garden with their pipes and fishing rods.

One shudders to think of the possibilities offered by the domain of Miss Enid Blyton. Let us hope that there will never be a Napier Noddy or a Bristol Big Ears, or organized children both inside and outside the aircraft industry will rise in revolt at this unpardonable intrusion into the realms of whimsy. But then, the aircraft industry is getting smaller. . . .—D.G.

LAST WORD.—In its issue dated February 3, *Aviation Daily* says that any statement by a British aircraft manufacturer regarding orders from Pan American should be regarded as premature.

RESEARCH RESOURCES.—While the new office block for Hawker Aircraft, Ltd., goes up apace on the front of their Richmond Road factory at Kingston, the new research department alongside which houses the Hawker P.1121 private-venture project is in occupation.

Photograph copyright "The Aeroplane"

NEW SEAMASTER.—Flight testing has begun with a new model of the Martin SeaMaster, the YP6M-1. It differs from the two earlier aircraft, which crashed, in having outswept engines and a modified tail unit. It has Allison J71 turbojets and is the first of six for evaluation.

IRBM TEST.—An American report indicates that the first test of the Rolls-Royce rocket engine for the de Havilland Propellers IRBM is to take place very soon at Aberporth. This engine has been developed under an agreement between Rolls-Royce and the Rocketdyne Division of North American Aviation.

BRUSSELS EXHIBITS. — "Rolls-Royce Power—on land and sea and in the air" is the theme of the Rolls-Royce stand at the Universal and International Exhibition to be held in Brussels from April 17 to October 19. The Dart and Tyne turboprops and the Avon and Conway will be on show.

GERMAN MERGER.—The Heinkel and Messerschmitt companies, now building the Air-Fouga Magister under licence, are to work together on new designs.

MISSILE CORRECTION.—In the summary of Mr. Bedford's recent lecture on missile guidance and control systems, on page 180, part of the mathematics has inadvertently become all Greek. In the right-hand column, about half-way down, the term $\lambda \rightarrow \omega$ should of course be $\lambda \rightarrow \infty$.

COMMERCIAL AVIATION AFFAIRS

(Levy-Shipp photograph)

FRENCH TOUR.—Following an agreement between the Bréguet company and Triframe in the U.S., a Deux Ponts is being demonstrated in the States. It is here seen at Idlewild airport, New York. The picture was taken from one of the "fingers" of the new arrivals terminal.

N.Y.A. ORDERS VERTOLS. — As already forecast, New York Airways are to purchase five 15-passenger Vertol 44Bs. Subject to C.A.B. approval, the first delivery will be in April, followed by three in May and one in June. Among the traffic increases which the new equipment will provide will be one to 600 seats per day in and out of Manhattan's 30th Street heliport. Present Manhattan schedules involve only 68 seats a day.

MORE F-27s. — Bonanza Airlines reportedly has taken up its option on three Fairchild F-27s, making its total order for this type six. According to *Aviation Daily*, Bonanza has now specified that all six aircraft should have Dart R.Da.7 turboprops.

CHANGE OF NAME.—Southwest Airways has obtained C.A.B. approval to change its name to Pacific Air Lines. Certain formalities remain to be completed before the change takes effect.

EMBAKASI OPENING.—H.M. The Queen Mother will open the new Nairobi Airport at Embakasi on March 8, and a large air display in which military and civil aircraft will participate is planned to be held on March 9.

IRISH AIRLINES PLANS.—Aerlinte plan to start operations over the Atlantic in the spring (see our previous issue, page 136). Three Lockheed L-1049H Super Constellations have been leased from Seaboard and Western and will carry an average of 95 passengers in economy-class seating for the non-stop Shannon-New York service. Initial frequency will be three services a week, increasing to seven a week during the summer peak.

COMET UTILIZATION.—The two Comet 2Es which are being operated by B.O.A.C. have now exceeded 2,000 flying hours, during which they have flown nearly one million miles. Since November the average daily utilization has been eight hours and they are now more than half way through the 3,500-hour programme of intensive proving and training flying.

A BRITANNIA YEAR.—During the 12 months to February 1, B.O.A.C.'s Bristol Britannias have carried nearly 77,500 passengers (at an average load factor of 72%) and flown 28,000 hours on revenue-earning operations. The average utilization has been about 6.75 hours per day and the Proteus 705 is expected to be certificated shortly to run 1,300 hours between overhauls.

INTO SERVICE.—Eagle Airways' two Viscount 805s went into service on February 3, operating initially on the Manchester — Hamburg — Copenhagen route at a frequency of twice a week. On March 4, the Manchester—Brussels—Frankfurt service will be inaugurated, and will be increased from once to twice weekly on April 1.

"Actually, Mrs. Finchley, Dr. Fuchs is at the *South* Pole, but you wouldn't be able to identify him from this height anyway."

NEWS ABOUT PEOPLE

APPRENTICE PRIZES.—At the 27th annual prize-giving ceremony of Blackburn and General Aircraft, Ltd. on January 20, T. Addison, (fourth from left) received the director's prize for the best all-round craft apprentice. With him are (left to right) B. Maskew, P. L. Snowden, J. M. Chaney and C. Bryant (Robert Blackburn memorial prizes).

CANADAIR APPOINTMENTS. — Following reorganization of the sales division of Canadair, Ltd., of Montreal, Mr. A. J. Lilly becomes director of sales; Mr. L. S. Adamson is director of service, parts, sales and special projects; Mr. K. H. Larsson is director of commercial aircraft sales, and Mr. A. G. Sims director of military aircraft and missiles sales.

MALAYAN RETIREMENT. — Capt. Roger Mollard, who was seconded by B.O.A.C. to Malayan Airways in 1947 and later became the airline's managing director, has retired following the reorganization of the company under joint B.O.A.C. and Qantas management. He has been succeeded by Mr. J. A. Vick, previously managing director of Cyprus Airways. Capt. Mollard has been in aviation since 1921, when he joined the R.A.F., and was with Imperial Airways and B.O.A.C. for 20 years.

PLESSEY DIRECTORS.—Mr. W. Dalziel, production manager, electronic and equipment group, and Mr. H. Fox Wright, contracts manager, have been appointed executive directors of The Plessey Co., Ltd., of Ilford, Essex.

JACKAROOS IN AFRICA.—Wg. Cdr. D. W. Balden has been appointed aviation sales manager of Jackaroo Aircraft (Africa) (Pvt.), Ltd., of Salisbury, S. Rhodesia. He served in the R.A.F. from 1933, when he entered the R.A.F. College at Cranwell, until his retirement last year.

AIR SAFETY AWARD WINNER.—Mr. James Martin, C.B.E., M.I.Mech.E., F.R.Ae.S., chief designer and managing director of the Martin-Baker Aircraft Co., Ltd., has been awarded the Laura Taber Barbour Air Safety Award for 1958, by the Flight Safety Foundation of New York. The award is international and was established in 1956 by an American, Dr. Clifford E. Barbour, to recognize notable achievement leading to aviation safety in method, design, invention or other improvement either in the civil or military field. Mr. Martin is to receive the award (the first Briton to do so) for his outstanding contribution to the safety of crews of high-performance aircraft through the design and development of ejection seats.

VICKERS SALES.—Mr. H. C. W. Sharp has been appointed assistant sales manager for the Middle and Far East by Vickers - Armstrongs (Aircraft), Ltd.

INSURANCE SECRETARY. — The directors of the British Aviation Insurance Co., Ltd., announce that Mr. Harold Caplan has been appointed assistant secretary as from February 1.

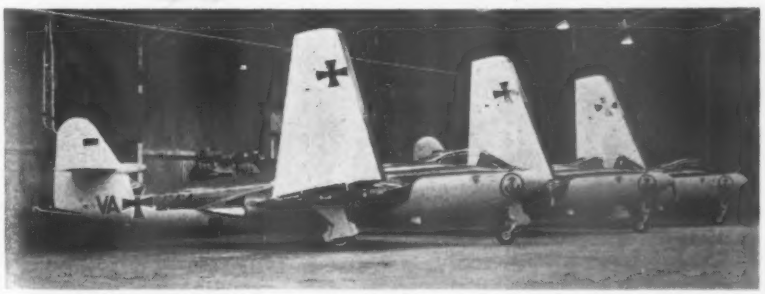
MILITARY AVIATION AFFAIRS

H.M.A.S. "SYDNEY."—The Australian Navy is to pay off its 10-year-old carrier "Sydney." As the first R.A.N. carrier to go into service, H.M.A.S. "Sydney" has been a general training ship since 1955, when she was replaced in the operational rôle by the "Melbourne."

PACIFIC AIRLIFT.—Lockheed C-130 Hercules Aircraft are to replace the Fairchild C-119 Packets for U.S.A.F. transport duties in the Pacific Air Command. Before the change-over eight Tactical Air Command C-130s are to be detached to Japan in March.

G.91 INTEREST.—A team from the West German Air Force recently visited Turin to evaluate the Fiat G.91 trainer, which has a Bristol Orpheus turbojet. The German team was closely followed by another from Turkey, for which a similar trials programme was organized.

TEAM WORK.—The 16 pilots of the Pakistan Air Force who fly the aerobatic Sabres illustrated on page 160. The leader, Wg. Cdr. M. Z. Masud, is in front.



BRITISH EXPORTS.—The first three of 68 Sea Hawks built by Armstrong Whitworth Aircraft, Ltd., awaiting delivery to the German Naval Air Arm a month ahead of schedule.

STARFIGHTER PROGRESS.—Lockheed F-104 Starfighters are now in operational service with the U.S.A.F.; the first three were delivered to Hamilton A.F.B. on January 26. Some 2,360 flights have been made by Lockheed pilots and a further 1,800 by U.S.A.F. pilots. There are 51 Starfighters now being used in flight testing, including one for missile testing at Holloman A.F.B. and two used as "chase" aircraft for Convair B-58 Hustlers.

COASTAL COMMAND.—The 1958 annual Coastal Command photographic competition, to judge the best photographs taken the previous year, was held at Command Headquarters last week. Winner of the Inter-station Cup was H.Q. Unit, Coastal Command, with R.A.F. Aldergrove runner up. No. 228 Sqn., R.A.F. St. Mawgan, won the Inter-squadron Cup with No. 224 Sqn., R.A.F. Gibraltar, second.

AIR TRANSPORT

"Who Shall Decide . . . ?"

SOME down-to-earth views on the situation over the B.E.A. turbojet transport requirement were expressed during an interview given by Rear-Admiral Sir Matthew Slattery, chairman of Bristol Aircraft and chairman and managing director of Short Brothers and Harland, to a small group of aviation journalists last Friday.

The main points made by Sir Matthew were these:—

The problem involved national issues, since the British aircraft industry, if it were to survive, had to become further established in the civil aircraft market and this short-haul turbojet might provide the last opportunity for the industry to become so established.

It was obviously useless to think of making such an aircraft merely for the home market. If no orders were obtained beyond that for 24 aircraft from B.E.A. then the firms concerned might find themselves £10 million out of pocket. Without firm export business the project was "just not on." It was, Sir Matthew said, essential that there should be the promise of such business before considering whether it was worthwhile to make the aircraft for B.E.A.

Bristol had been invited by Pan American Airways in December to go over at a convenient later date to discuss their turbojet transport project. The talks had been going well and a form of contract (a third draft) was already being considered. If this and/or other orders of sufficient sizes were obtained the Bristol-Hawker consortium might go ahead even without B.E.A. support—but any such decision would be made only on a hard commercial basis.

Sir Matthew suggested that it would be prudent for the Government and B.E.A. to delay their decision for a few weeks until the export business position had been further examined.

Commenting later on this suggestion, Lord Douglas remarked that "it is surely not suggested that B.E.A. should leave the choice of their new jet aircraft to a foreign airline or airlines."

The de Havilland view on such a "wait and see" policy appears to be that it would surely be more practical at this stage to go ahead on the basis of a firm order from a home operator than on less certain orders, or letters of intent, from U.S. operators. For B.E.A. the matter is urgent; the Corporation cannot wait months while Bristol and de Havilland do battle for overseas orders for what is, after all, no more at present than a "paper aeroplane." No U.S. carriers will wish to buy British if they can buy American.

B.E.A. (whose chairman said firmly last week that the Corporation wished to order the D.H.121 and was now awaiting Government approval) must have an aircraft tailored to suit its own network, and an aircraft modified for U.S. domestic and overseas stage-distances would not be as suitable for B.E.A. and might even lose money for them. The probability is that the B.E.A. specification would be attractive to European and other (non-U.S.) operators and that an aircraft with a "B.E.A. performance" is thus more likely to sell in those countries which have no aircraft industries of their own.

Meanwhile, speaking of the future of the aircraft industry at a Press conference at the new Armstrong Siddeley gas turbine and rocket centre at Ansty, near Coventry, on January 28, the Minister of Supply, Mr. Aubrey Jones, said he had been much maligned for attempting "shot-gun marriages" between aircraft firms.

"I have never said that 'A' should marry 'B,'" he asserted. "I have merely said to an individual contractor that if, alone, he could not do a job, he ought to look to some association with others to strengthen his ability to do it. I have assiduously avoided the word 'amalgamation.' I have always used the word 'association'."

This forceful denial arose out of questions on the B.E.A. contract, on which, he said, no decision had yet been taken. The B.E.A. requirement, he thought, should be looked at from the point of view of three criteria:—(1) Was there any difference between the alternatives so far as meeting B.E.A. requirements was concerned? (2) Was there any difference between them as to ability to enter the export field—and that was of more importance than the B.E.A. contract if only because the latter was so uneconomic? (3) Which offered the best basis for the production of future civil aircraft?

An artist's impression of the projected D.H.121.

B.E.A. wanted only 24 aircraft and no one was going to break even on this project unless they built 80 aircraft, whilst 110 to 120 would have to be built to show a reasonable profit.

On the subject of exports, the Minister said that the aircraft and aero-engine industry must go beyond what had been done in the past and go for exports without a big home demand. Asked what made him think that this country differed from others in being able to export without the backing of a big home market, Mr. Aubrey Jones said that in terms of aero engines there was virtually only the U.S. and Britain. By reason of geography, the U.S. had a tremendous home market. We had not. Therefore we must try to export regardless of home demand. He saw no reason why this could not be done.

In the past, the Minister said, the aircraft industry had been organized in small units without enough capital to finance their own developments. In future, the industry must organize itself into larger units which could be self-supporting.

On the subject of how the industry could strengthen its position, Mr. Aubrey Jones said that some units were strong in civil aircraft and some in military aircraft. The ideal unit would be one which was making both civil and military aircraft and which also had behind it a diversified industrial structure which could add to its credit-worthiness and strengthen its call on the capital available.

U.S. Domestic Fare Increase

WHILE the General Passenger Fare Investigation grinds its way laboriously on in Washington, the C.A.B. has announced a surprise decision to permit a limited fare increase on U.S. domestic air routes. The increase permitted, of a flat 4% plus $1 per single ticket, falls far short of that which the domestic trunk carriers say is necessary to establish stability in the industry. Several airlines had already requested, or were planning to seek, increases of between 12% and 15%, as an interim measure, until the outcome of the G.P.L. investigation should be known—which is not expected for another 12 months or so.

Most of the operators concerned are expected to take immediate advantage of the increase, which has been devised to give rather more advantage to the short-haul carriers than those with a preponderance of long stages. One immediate consequence of the increase was the withdrawal by Capital Airlines of their request for a subsidy. In a letter to the C.A.B., Capital's chairman said that the position had been altered by the increase, by a reduction in forecast losses for 1958 based on current operating results and, to some degree, by the airline's recent agreement with General Dynamics Corporation. (See page 167.)

Convairs for Capital

THE report—which is now confirmed—that Capital Airlines are to buy up to 15 Convair 880 medium-haul turbojet transports focuses attention once again on the "dark horse" of San Diego. Since T.W.A. and Delta jointly announced their intention of purchasing, respectively, 30 and 10 examples of the new Convair design in September, 1956, comparatively little enthusiasm seems to have been aroused among those airlines which Convair regard as prospective customers. Additional firm orders have been announced, for four aircraft each, from Transcontinental S.A. (the new Argentine carrier) and from REAL Aerovias of Brazil, but Convair badly needed, and were sorely disappointed to lose, the United Airlines medium-haul contract which after a close evaluation went to Boeing for the 720 (described in THE AEROPLANE last week).

In recent months, there has been speculation over the future of the 880 project and even reports that it might be dropped. Such rumours in fact have no substance, and as we recently recorded, the company has already spent or committed $50 million on the project, including $10 million in engineering costs. It is, however, significant, that the Capital purchase is being wholly financed, in an unprecedented move, by the powerful General Dynamics Corporation—of which Convair is a division. General Dynamics are said to be offering Capital a credit of some $109 million, of which $60 million will be spent on the Convair 880s and the remainder will serve to re-finance in part Capital's purchase of 60 Viscounts. This arrangement is a measure of the length to which U.S. aircraft manufacturers are now prepared to go to obtain—or retain—the custom of both American and foreign airlines.

The Convair 880s for Capital will be delivered with a mixed-class layout, for a total of 94 passengers, and the first aircraft is scheduled to be handed over in September, 1960. The initial commitment is for nine aircraft with a firm option on another six, dependent upon obtaining further route rights.

Apart from the Capital order—which quite clearly eliminates the de Havilland Comet finally from that airline's plans—Convair hope soon to obtain new encouragement from American Airlines. A version of the 880 has been developed to meet an American Airlines' specification for a medium-haul turbojet, which the airline apparently requires to take over some of its Electra services in 1962-63. To meet this requirement, Convair have increased the weight of the 880 from 178,500 lb. to 200,000 lb., without altering the overall dimensions.

Meanwhile, the General Electric CJ-805, commercial version of the J79 to be used in the 880, has completed an acceptance test for commercial powerplants, comprising a 1,000-hr. endurance run simulating 600 representative flights of between 375 to 1,235 miles each. The first Convair 880s will be powered by four CJ-805-3s, rated at about 11,500 lb. s.t. each.

Production of the 880 will be concentrated in two existing buildings at San Diego, where the aircraft will be, in Convair's own words, "a tight fit." Close attention has had to be paid to the capacity of overhead cranes, the height of the buildings and the size of door openings. The assembly line, with the aircraft moving backwards, will run down one side of both buildings, mating of the wing and fuselage taking place at the end of the first building and final assembly in the second building.

An impression of the Convair 880 in Capital's colours.

The mock-up of the 880, which was used in its earlier stages to prove design features, has recently been fully furnished, as we showed last week. The basic decor, designed by Harley Earl Corp., is expected to be used by both T.W.A. and Delta, although the colours in the mock-up, with fabrics styled by Dorothy Draper, Inc., are to Convair's choice and may be changed. To avoid the use of partitions while at the same time breaking up the continuous lines of the cabin-interior, different ceiling levels have been used, and each block of three-seat rows is in a varying colour shade.

The first 880, built on production jigs, is scheduled to be rolled out in November and to make its first flight in January, 1959.

Studying the Economics of Transport

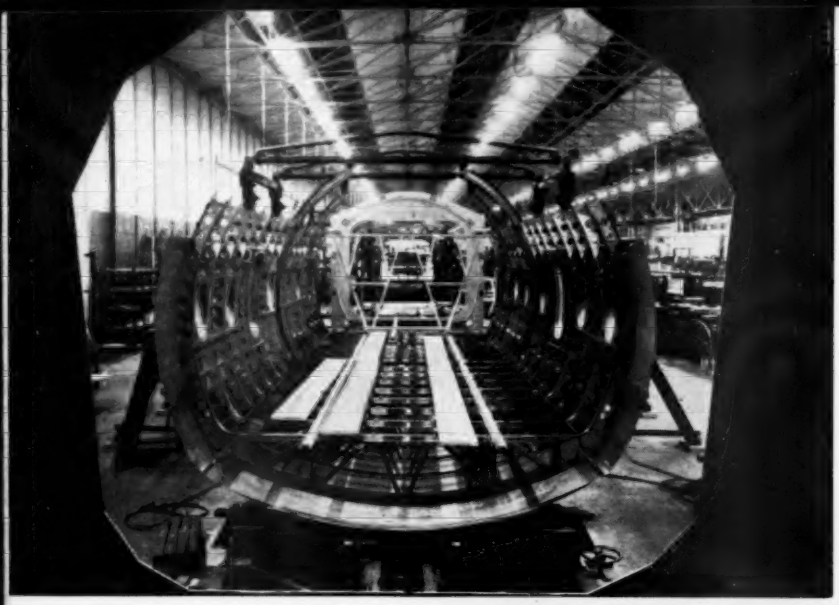
DURING the past two years the Institute of Transport has been sponsoring a project to establish at the University of Oxford a Readership and Research Fellowships in the economics and organization of transport. A substantial sum of money was required to initiate the project and a sufficient sum has now been promised by associations and individual undertakings in or connected with the transport industry, and by users of transport, to enable the Institute to make a formal offer to the University. This offer was welcomed by the Hebdomadal Council of the University and the Institute has now completed a Covenant to transfer the donations to the University over the next 10 years.

The scheme, in its final form, will cover not only a Readership but also the establishment of at least two Research Fellowships in the colleges; provision is also made for the giving of grants to other members of the University to encourage and advance the study.

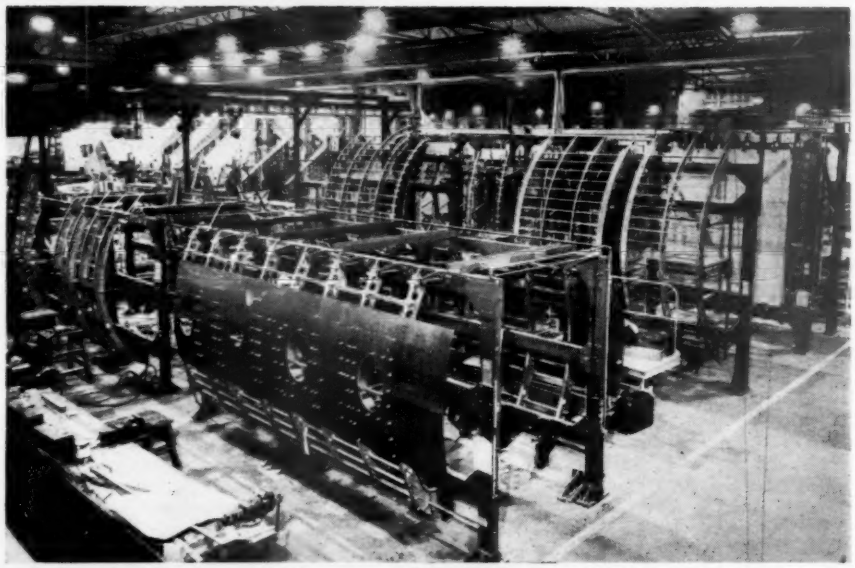
NEW FOR NAIROBI.—Her Majesty The Queen Mother will perform the official opening ceremony at Nairobi's new airport, at Embakasi, on March 8. This recent picture shows the terminal building, designed to handle 200,000 passengers a year, nearing completion.

D

Building Two New British Airliners



The pictures above and right show the progress which is being made at Baginton with production of the Armstrong Whitworth A.W.650, about which we wrote in THE AEROPLANE for January 17. The first fuselage, which will be used for static testing, is taking shape in the main fuselage jig (above), while fuselage segments for later aircraft—ten flying and two test specimens are being built initially—are seen in their assembly jigs, right.



The Vickers Vanguard, which like the A.W.650 is expected to make its first flight towards the end of this year, is coming on apace at Weybridge, and the picture on the left is the first view inside the first flying example; the test specimen in this case is to be the second airframe built. An unusual feature of the first three Vanguards, to be used in the certification trials, is the provision of three emergency escape chutes in the fuselage floor, for the benefit of the flight test crews; these will be removed when the aircraft are eventually refurbished for delivery to B.E.A.

Local Service Viscount

FOR some months it has been known that Vickers and certain of their prospective customers were interested in a specialized short-haul version of the Viscount and a note to this effect, with some figures, appeared in THE AEROPLANE of October 18 last year. At that time, Vickers were not ready to make an announcement about this variant and full information only became available last week.

The Local Service Viscount, as the new 790 Series is known, has been developed initially to meet the requirements of the smaller U.S. operators whose average stage distance is less than 100 miles. But it will be of equally obvious interest to other short-haul carriers whose traffic is increasing—and particularly to those whose services act as feeders to trunk routes. As new trunk-line equipment comes into use everywhere there may be a sharper increase in traffic and this will undoubtedly cause a proportionate increase in feeder-service traffic.

The 790 is, in effect, a 700 in which modifications have been made—mostly by the use of structural changes which have already been incorporated in later Viscounts—to permit the use of higher landing weights and higher cruising speeds at low altitudes. The interior layout has been redesigned to give greater seating capacities and the different versions can accommodate from 54 to 65 passengers.

For local service operations an aircraft must be capable of making a series of short flights without intermediate refuelling, without ground servicing at the transit stops and with a minimum in the way of traffic-handing facilities—and must achieve quick turn-rounds. Because of the short distances involved and the congestion on the higher airways, the aircraft must be capable of cruising at low altitudes without serious speed limitations. Obviously, too, the take-off and landing performance must match the available airports.

Because the 790 will normally cruise at comparatively low altitudes, the cabin pressure differential has been reduced from 6.5 to 4.5 p.s.i. (giving sea-level conditions at 10,000 ft. and 7,000 ft. equivalent at 20,000 ft.). Only one blower is therefore needed and weight saved. At short-haul traffic stops No. 4 engine will normally be kept running to provide electrical power to restart the other three engines. If all four engines have to be stopped, an increased capacity permits normal restarting on the aircraft batteries. At terminal airports starting will be completed by trolley. In the same way refuelling will normally be required only at terminal airports, using under-wing pressure refuelling. Over-wing refuelling points are, however, provided.

So that neither steps nor ladders will be required for ground handling, folding air steps are carried inside the forward entrance door. The windmilling of propellers on this (port) side is prevented by the use of brakes on Nos. 1 and 2 engines. No. 3 engine also has a propeller-brake so that the belly-hold freight doors on the starboard side of the fuselage can be opened without danger.

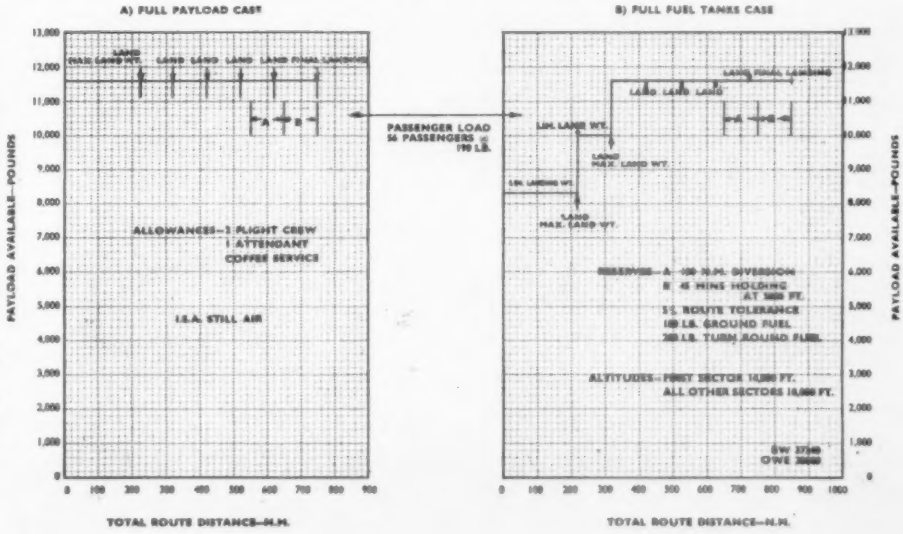
The Rolls-Royce Dart 506 engine was chosen in preference to later marks for a number of reasons. The 506 has, for instance, a greater background of operating experience in local-service conditions, and it is both cheaper and lighter than later marks. The 506 does not use water-methanol for power restoration below 80° F., so that the 790 should rarely require replenishment at transit stops. The Rotol high-activity-factor parallel planform propeller, developed for the Dart 510, is to be used and as the Dart 506 has higher propeller r.p.m. than the 510, the take-off thrust will approximate to that of a 510-powered Viscount.

The standard version of the 790 accommodates 54 passengers in 13 rows of four-abreast seats at a 34-in. pitch. This version has the rear freight hold, as in most Viscounts, immediately forward of the aft pressure bulkhead; in addition there is a large under-floor forward freight hold. An alternative version features lounge-type seating in the rear cabin and provides a total seating capacity for 60 passengers while retaining the four-abreast layout. If five-abreast seating is used the capacities of the two versions are increased to 59 and 65 passengers respectively. The aisle-width is 35 in. in the four-abreast layout and 16 in. in the five-abreast layout. This aisle-width is a minimum figure; in the 59- and 65-passenger versions the five-abreast rows alternate with four-abreast rows, thus providing "lay-bys." To save space there is only one lavatory and no pantry.

The 790 is not a new aircraft and the various elements from which it has been developed are already in production, so an initial delivery date of approximately mid-1959 can be offered. For the same reason, the price, at about £380,000, is lower than that of other Viscount Series.

The estimated costs show that these may, even over very short stages, be 10% less per seat-mile than those of existing DC-3 fleets. The outline figures for the 790 are as follows:—

Max. take-off weight, 61,500 lb.; max. landing weight, 58,500 lb.; zero-fuel weight, 50,000 lb.; weight empty, 37,240 lb.; seating capacity, (standard) 54-59, (alternative) 60-65; freight-hold capacity, (standard) 399 cu. ft., (alternative) 174 cu. ft.; max. payload, (standard) 11,620 lb., (alternative) 11,555 lb.; max. cruise speed, 320 m.p.h.; range (with full payload plus reserves for 115-mile diversion and 45 min. holding at 5,000 ft.), 800 miles; take-off distance to 50 ft. (I.S.A., 61,500 lb.), 4,850 ft.



These graphs show the basic forms of the Viscount 790's payload-range performance. From the left-hand graph, it will be seen that the 790 with max. payload of 11,600 lb. can fly an initial stage of 220 nautical miles and three more stages of 100 nautical miles each without refuelling; the influence of fuel reserves for diversions and holding is also shown. With full tanks (right-hand graph) the initial payload is 8,300 lb. for the first 220-mile stage, 10,000 lb. for the next 100 miles and the maximum of 11,600 lb. for another three 100-mile stages.

North Atlantic Traffic Trends

STATISTICS for eight operators over the North Atlantic, on a quarterly basis for five quarters, are shown in the table on this page. They have been supplied by these airlines at our request to comprise the first set in a series which is planned as a regular quarterly feature. A similar set of statistics for European traffic was printed in THE AEROPLANE last week.

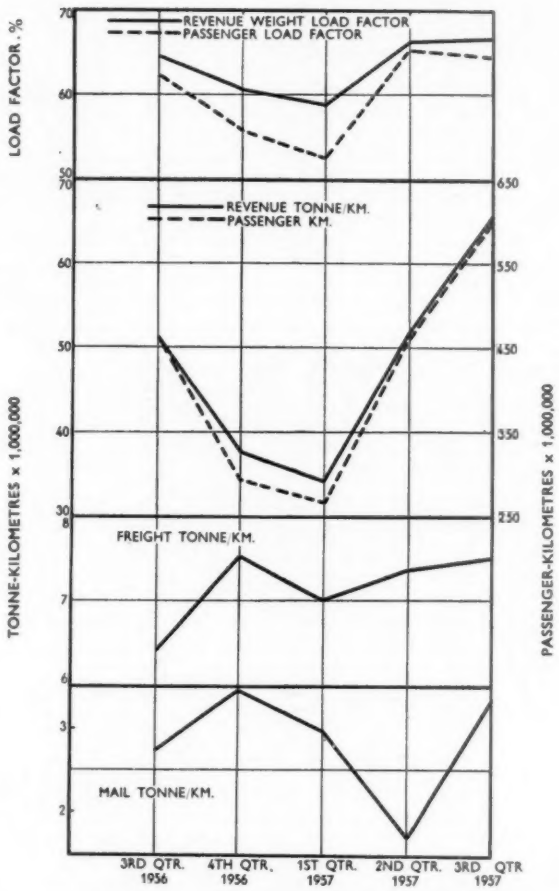
This present survey is concerned with operations on the North Atlantic only. Services via the Arctic, from the east or west coast of North America to Europe, are regarded as being essentially part of the North Atlantic traffic and are included.

A few of the operators have unfortunately felt that they cannot supply statistics which we require, and the total picture presented here in the form of six curves should therefore be taken only as representative of the overall trends. The particular total values are the sums of the eight results tabulated in each case, and are not in themselves significant.

It is interesting to notice that the pattern of traffic on the North Atlantic almost exactly duplicates the European trends, with the big passenger slump in the fourth and first quarters, and some small compensation for this from extra mail and freight around Christmas. The high proportion of business traffic on the Atlantic plus the emigrant traffic might have been expected to reduce the severity of this winter trough.

So far as the tabulated statistics are concerned, these are worthy of close study. We have related the results for July-September, 1957 to those for the same quarter of 1956, and have expressed this relationship as a percentage change in the final column of statistics for each airline. Other deductions and calculations can be made from the figures presented, according to the specific needs and interests of our readers.

It is satisfying to note that B.O.A.C. is at last making progress at least as good as the overall average. The Alitalia-L.A.I. result reflects the difficulties which beset L.A.I. in particular in this period, the load factors for this airline in the first quarter of last year being the lowest of any in the tables. The C.P.A. mail figure in July-September, 1956 was unnaturally depressed and the startling increase of 380% shown is not therefore indicative of any sudden change in the situation. Iberia showed unusually large growth of freight and mail traffic over the Atlantic, as also in the European results. The most striking increase in revenue tonne-km. flown was recorded by Sabena, despite a small reduction in mail traffic.



These curves, prepared by THE AEROPLANE, show Atlantic traffic trends on the basis of eight operators' results.

	3rd qtr. 1956	4th qtr. 1956	1st qtr. 1957	2nd qtr. 1957	3rd qtr. 1957	3rd qtrs. % change	3rd qtr. 1956	4th qtr. 1956	1st qtr. 1957	2nd qtr. 1957	3rd qtr. 1957	3rd qtrs. % change
	ALITALIA—L.A.I.						B.O.A.C.					
Passengers carried ..	7,533	3,644	1,481	4,446	7,159	− 4.9	31,138	20,269	19,079	32,434	34,869	+11.9
Passenger L.F. %	52.3	40.9	22.0	42.7	50.2	—	68.9	61.0	62.1	73.4	72.7	—
Passenger km. (x000) ..	39,880	19,159	7,031	21,091	38,650	− 3.1	166,993	108,826	97,883	175,206	225,414	+34.8
Freight tonne-km. ..	437,756	622,155	427,255	504,274	500,458	+12.6	1,596,377	1,811,224	1,805,296	1,868,722	2,234,401	+46.3
Mail tonne-km.	364,655	292,604	204,438	296,076	404,252	+ 9.9	1,056,676	1,425,605	1,277,121	1,234,944	1,181,325	+11.7
Total tonne-km. (x000) ..	4,439	2,665	1,275	2,729	4,426	+ 0.3	17,648	13,360	12,234	18,161	23,655	+35.3
Revenue L.F. %	57.2	52.7	37.5	54.3	57.3	—	62.1	60.4	61.2	64.9	64.9	—
	C.P.A. (POLAR)						EL AL					
Passengers carried ..	2,957	2,003	1,991	3,365	4,037	+40.0	3,095	1,525	1,327	2,080	3,122	+ 0.87
Passenger L.F. % ..	64.0	63.0	65.0	75.4	70.6	—	66.9	54.7	44.0	65.4	72.1	—
Passenger km. (x000) ..	23,008	15,585	15,492	26,183	31,412	+37.0	17,479	8,634	6,323	11,527	17,282	− 1.13
Freight tonne-km. ..	251,013	351,777	203,160	217,322	250,858	− 0.04	237,000	271,000	280,000	206,000	237,000	+ 0.0
Mail tonne-km.	13,773	55,011	55,089	44,507	66,760	+380.0	46,000	41,000	31,000	34,000	59,000	+28.3
Total tonne-km. (x000) ..	2,174	1,605	1,499	2,352	2,800	+27.3	1,905	1,120	906	1,313	1,895	− 0.5
Revenue L.F. %	72.4	68.3	68.1	80.9	76.7	—	62.7	59.6	53.2	63.8	68.5	—
	IBERIA						LUFTHANSA					
Passengers carried ..	4,738	4,021	2,766	4,649	5,657	+21.2	16,577	9,383	7,314	14,295	17,382	+4.87
Passenger L.F. %	55.0	53.2	47.8	53.9	55.8	—	57.5	52.7	61.2	69.8	70.6	—
Passenger km. (x000) ..	31,463	26,671	17,805	28,631	34,909	+11.1	74,126	44,466	45,792	67,652	83,359	+12.5
Freight tonne-km. ..	92,394	161,816	165,404	123,609	145,901	+58.7	929,734	904,938	624,243	853,908	1,028,000	+10.5
Mail tonne-km.	56,337	67,284	64,250	57,198	68,092	+21.4	567,592	712,280	501,282	641,183	770,100	+35.7
Total tonne-km. (x000) ..	3,087	2,771	1,868	2,599	3,444	+11.6	8,180	5,571	4,540	7,595	9,160	+11.9
Revenue L.F. %	59.3	56.0	52.7	53.1	52.4	—	49.3	51.5	53.0	60.0	63.4	—
	SABENA						SWISSAIR					
Passengers carried ..	11,910	6,982	7,411	13,579	17,658	+48.3	7,932	5,539	5,751	9,251	11,139	+40.5
Passenger L.F. %	60.0	57.5	50.5	68.7	65.2	—	75.2	64.1	68.2	71.7	76.6	—
Passenger km. (x000) ..	54,143	34,310	36,891	70,129	91,820	+69.6	53,303	36,143	39,948	64,618	81,072	+51.9
Freight tonne-km. ..	1,123,244	1,384,113	1,731,592	1,639,943	1,436,625	+28.0	1,740,000	2,017,000	1,764,000	1,931,000	1,676,000	− 3.7
Mail tonne-km.	276,045	373,241	380,786	322,799	251,503	− 8.9	342,000	480,000	445,000	464,000	440,000	+28.5
Total tonne-km. (x000) ..	6,663	5,109	5,589	8,539	10,352	+56.2	7,150	5,977	6,107	8,607	9,823	+26.8
Revenue L.F. %	72.7	75.4	71.2	79.2	72.4	—	72.2	67.2	73.0	72.9	75.2	—

AERONAUTICAL ENGINEERING

Nuclear Power in Aviation

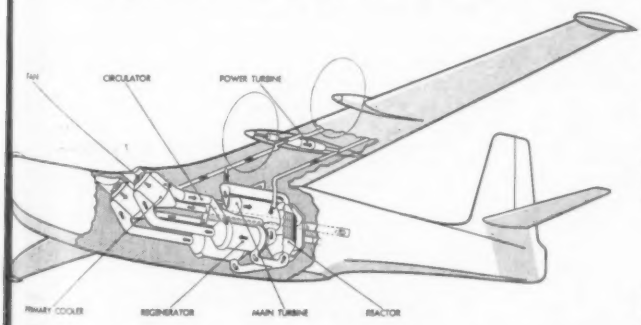
At a recent R.Ae.S. main lecture, in Leicester, attention was once again sharply focused on nuclear energy as a source of power for aircraft. In this context, this survey of the possibilities—made by* MR. A. D. BAXTER, M.Eng., M.I.Mech.E., F.R.Ae.S., *chief executive of The de Havilland Engine Company's Nuclear Power Group and* MR. G. E. PREECE, D.C.Ae., A.F.R.Ae.S., *nuclear projects engineer—is of especial interest.*

IT is not unnatural that the aero-engine concerns in this country should be greatly interested in pioneering developments in the nuclear field. Their experience in the manufacture of highly intricate and refined forms of heat engine can be applied directly to the design of the new forms of powerplant which are necessary for specialized applications of nuclear power. Other practical contributions can be made by utilizing their extensive research facilities in the fields of heat transfer, gas dynamics, control engineering, instrumentation, materials and fabrication techniques.

Since a nuclear reactor may be regarded as simply a controllable source of heat, it follows that it is possible, in theory at least, to use this in conjunction with any of the existing forms of heat engine and the nuclear equivalents of conventional power units can be readily derived.

Whilst no attempt is made to discuss the various types of reactor systems in detail, it is of interest to note that if pure fissile material is employed as the fuel, the size of core is likely to be dictated by heat-transfer considerations, and the critical size of the system could be adjusted accordingly by varying the amount of moderator or fertile material present. Fast systems employing no moderator might have cylindrical cores of less than 2 ft. in diameter by 2 ft. long, whereas thermal systems might be any size from 2½ ft. in diameter upwards, depending on the fuel and moderator used.

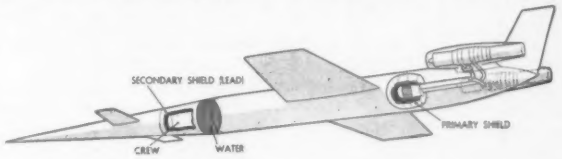
The energy released by the fission of uranium is so enormous that less than half a pound would be consumed by a large nuclear-powered aircraft in a trip around the Earth. Faced with this tantalizing prospect of virtually unlimited range, the aircraft companies in Britain and the United States have concentrated much thought, and in the latter country vast sums of money, in attempts to devise practical propulsion systems.



The powerplant layout for a large four-engined flying-boat. A gas-cooled reactor is used with a closed-cycle gas turbine in which helium is the working fluid. The helium is heated in the reactor and then expands through a power turbine connected to each of the propellers.

The crucial problem is that of reducing the weight of the radiation shield to a value which is at least comparable to the all-up weight of current large transport aircraft. The difficulty is conveniently illustrated by considering the shielding required around a spherical core 3 ft. in diameter. (This represents about the minimum size of core assembly likely to be achieved in practice.)

If the shield is comprised of the same materials used for the BEPO reactor at Harwell (i.e., 6 in. of steel on the inside surrounded by 6½ ft. of concrete), then the total weight of the shield would amount to the unacceptably high figure of 500,000 lb. In this over-simplification no account has been taken of the higher power level at which the aircraft reactor would have to operate, or the increase in radiation level associated with the much smaller size of core. However, these adverse factors could be partly compensated by employing a wider range of carefully selected shield materials positioned to give minimum weight for the geometry considered.



A hypothetical supersonic bomber designed to operate at around Mach 2.5 at 60,000 ft. A single gas-cooled reactor supplies 90 MW. of heat to a pair of turbojets. The reactor is partially shielded to provide a radiation "shadow" in the forward direction. Additional secondary shielding around the crew compartment reduces radiation to an acceptable level for short-term exposure.

Unless one is prepared to consider aircraft weighing upwards of one million pounds, therefore, the only alternative is to reduce the degree of shielding in those areas around the reactor which are not directly in line with the crew or passengers. By this means it is possible to produce a radiation shadow around the occupied portion of the aircraft which provides adequate protection for personnel inside, while in other areas the radiation intensity might be far in excess of the safe level. Needless to say, with this form of shielding the reactor could only operate when the aircraft had reached a reasonable altitude, and consequently some form of auxiliary powerplant would be necessary for take-off, climb and landing.

Core Design

There appear to be no fundamental obstacles which prevent the design of acceptably small cores capable of producing sufficient heat to power a large subsonic aircraft. It is probable that a gas or liquid-metal cooled reactor with an output of 30 MW. of heat could be designed to fit inside a 3-ft.-diameter by 3-ft.-long cylindrical envelope. If operating temperatures in the region of 750° C. can be achieved, then this output should be adequate to supply the cruising power of around 10,000 h.p. required by an aircraft weighing 200,000 lb.

Take-off and landing, normally the most hazardous manœuvres in the flight plan, would be carried out with the reactor shut down and the thrust supplied by auxiliary fuel-burning turbojets and rocket engines, which are retracted when cruising. This would involve some weight penalty, of course, but with the high thrust/weight ratios now obtainable this should not be too serious.

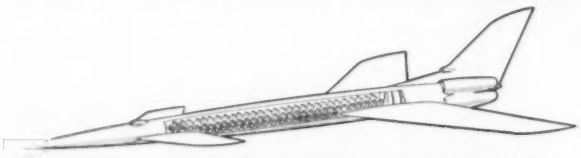
Further study is required to indicate the best system for this application, but preliminary investigations suggest that thermal or intermediate designs are likely to be most attractive. Since pure fissile material is proposed as the fuel, the core size will be determined by heat-transfer considerations for all types.

One of the problems associated with thermal systems is the poisoning, or loss of reactivity, caused by the formation of the

* Extracted from an article which is to appear in the *de Havilland Gazette* this month.

high cross-section fission product xenon 135. This is particularly serious with highly rated reactors such as are required for this application because, under certain conditions, control becomes difficult.

It is, perhaps, surprising to find that the volumetric heat ratings of gas-cooled systems should be adequate for propulsion reactors. This is the case only for designs in which the fuel is dispersed throughout the moderator, because this appears to be the only practicable means whereby the surface area presented



A typical layout for a large transport aircraft to operate in the region of Mach 1 at heights of 50–60,000 ft. A single reactor with a heat output of 100 MW. supplies four turbojets around the tail.

to the coolant can be made adequate without the introduction of an undesirably large amount of neutron-absorbing material for canning, etc.

All three solid moderators, graphite, beryllium and beryllia, might be used as a matrix to contain the fuel dispersion in the form of either uranium oxide or uranium carbide. Graphite is attractive, particularly if very high temperature operation is envisaged (e.g., the nuclear rocket), but the use of beryllium or beryllia would result in a smaller system.

Several forms of core structure might be employed, but perhaps the simplest could consist of a solid block perforated with holes for the cooling gas to flow through.

One very interesting possibility is the direct coupling of an air-cooled core with a gas turbine. This results in a very simple layout in which the air is fed from the compressor through the reactor core and then expanded down through the turbine.

The biggest disadvantage of this scheme is that the cooling air would become radio-active as a result of both irradiation and contamination by any fission products released from the fuel matrix. The latter effect may be eliminated if the fuel dispersion can be confined to the interior portion of the moderator, leaving a protective coating in contact with the cooling air. If this does prove to be feasible, then the activity produced by irradiation alone is not likely to be serious for the aircraft application providing the reactors operate only at high altitude.

The alternative to straight-through air cooling is to employ a closed-cycle gas turbine using hydrogen or helium as the working fluid. The circuit can be maintained at a high absolute pressure to reduce the losses in the circuit and improve the heat-transfer conditions in the core.

Economics—and Safety

It is almost impossible to make a realistic estimate of operating costs at this stage as a result of the lack of data on fuel processing methods and costs. Some encouragement can be obtained, however, by comparing the direct operating cost using pure fissile material with that of kerosene. The current price of nearly pure U 235 in the United States is quoted as £6 per gram. If it is assumed that the fuel is rejected for use in the aircraft reactor after a burn-up of 10%, then the cost per kilowatt-hour of heat is about 0.6d. However, if the rejected fuel can then be reprocessed at a cost of, say, £1 per gram, the cost per kilowatt-hour is reduced to only 0.15d.—almost exactly the same as for coal in a modern power station. The corresponding figure for kerosene used as fuel is 0.33d. per kilowatt-hour of heat produced.

Whilst it is not suggested that these estimates should be regarded as anything but a rough guide, they nevertheless do indicate that, fundamentally, the cost of nuclear propulsion is not high and may eventually prove to be lower than that obtainable with chemical fuels.

The most serious aspect to be considered in connection with the operation of nuclear-powered aircraft is the situation arising in the event of a crash. If this were to happen over land, particularly in a densely populated area, the consequences could be very serious. The main risk is that the fission products may escape from the core and contaminate a wide area with radio-active material.

A secondary danger is that if the core becomes detached from the main body of the shield the radiation intensity in the near vicinity will be so high that the lives of rescue and salvage personnel would be endangered. Furthermore, the absence of cooling, other than that obtainable by natural convection and radiation to the surrounding atmosphere, will result in very high temperatures being reached as a consequence of fission-product heating. This would probably result in the melting of the core structure, and if a liquid is used for cooling this would vaporize.

In view of the foregoing hazards it is considered that in the first instance a flying-boat confined to operation over water is the logical solution.

Safety considerations also favour the use of auxiliary propulsion units, since these would enable the aircraft to land safely if the reactor shuts down for some reason which, in itself, would not endanger the aircraft. Indeed, it may be possible to install sufficient reserves of kerosene fuel in the form of reactor shielding to ensure that the aircraft could fly to a safe landing area if failure occurred at any point en route.

The use of pure, or nearly pure, fissile material is very desirable from the point of view of reducing the fuel investment, but it results in a limited useful life or "burn-up." As an example we may consider a core containing 5 kg. of fissile material. If this operates with a steady heat output of 30 MW., then the fissile atoms are destroyed at the rate of 30 gm. per day. Assuming that the design of the core is such that it will continue to function until 10% of the fissile atoms are destroyed, then the useful life is only about 16 days. At this point the fuel must be taken from the core and the fission products removed. New fissile material must be then added to make up the new charge.

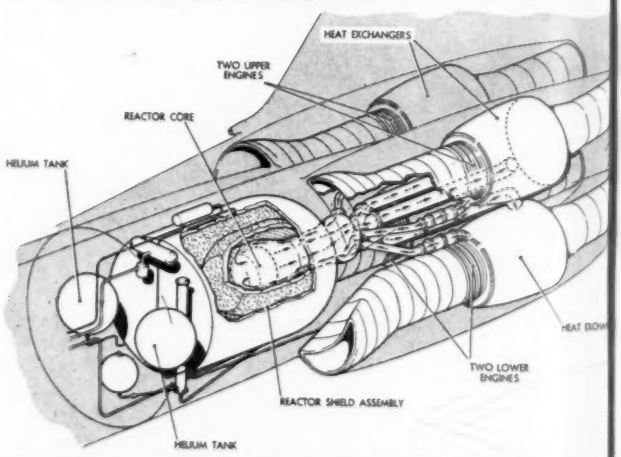
This is one of the least satisfactory features of pure-fissile cores. Some extension of the useful life can be obtained by introducing a fertile component, such as uranium 238 or thorium 232, but this must be at the expense of increased core size. Whether some compromise in this direction is possible can only be determined by a more detailed examination of various core designs.

It is clear that there is much to be said in favour of fluid fuels for this application since the processing of these may be possible without the need for elaborate decontamination procedures, and handling problems may be eased. Solid-fuel elements for homogeneous gas-cooled reactors present a more difficult problem since it will first be necessary to separate the fuel from the moderator.

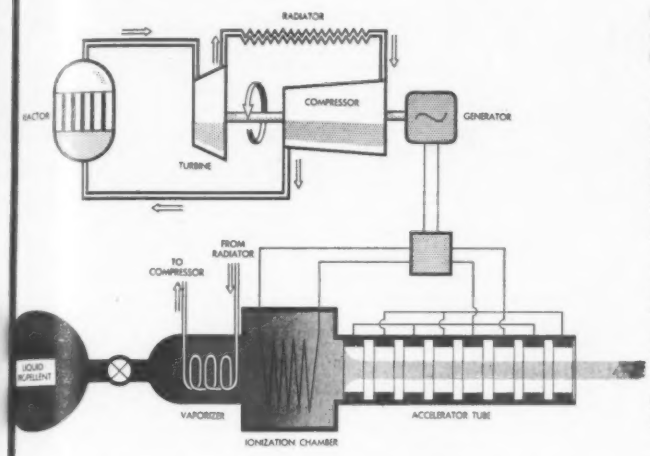
The Nuclear Rocket

The performance of a rocket engine is characterized by the velocity of the exhaust gases or the specific impulse defined as the thrust per unit mass of propellent ejected in unit time.

The specific impulse obtainable with chemical propellents is limited to some upper value determined by the heat released by the reaction and the physical properties of the resultant gases.



The layout of the nuclear powerplant for a large transport aircraft in which the reactor is cooled by helium at a pressure of 1,000 lb./sq. in. The heat exchangers, operating at temperatures of around 1,000° C., replace the combustion system of a conventional turbojet. The cooling gas is circulated by a small engine-driven compressor in the return circuit from the heat exchangers.



The ion rocket is possibly the space propulsion unit of the future. Ionised or charged gas is accelerated to very high velocities in a field produced by electricity generated in a nuclear gas turbine powerplant. The gas may be ionised by electrical means (as shown here) or, in the particular case of certain liquid metals, by a catalytic reaction of the vapour with tungsten or other metals.

For current rocket engines this value is around 220 lb.-sec./lb. mass flow, but the use of more energetic propellent combinations, such as hydrazine and oxygen, may allow values of 300 lb.-sec./lb. to be achieved in the next decade.

One form of nuclear rocket envisages the use of a single working fluid which is pumped through the reactor core, wherein its temperature is raised to around 3,000° C. This hot gas is then expanded in the conventional manner through a regeneratively cooled supersonic nozzle. The working fluid chosen should have a low molecular weight to enable the highest exhaust velocities to be achieved for a given chamber temperature and it must also be a good reactor coolant.

In these respects hydrogen would be an ideal choice, but it has the unfortunate drawback of being difficult to store in the liquid form because of its low boiling point (−259° C.). Its low density (0.07 gm./c.c.) is a further disadvantage which results in bulky and, therefore, heavy propellent tanks.

For the chamber temperature quoted (3,000° C.), estimates made for various working fluids indicate that the specific impulse for a nuclear rocket is between 50% and 100% better than that obtainable in the best chemical engine using the same fluid as one of the propellents. It should be noted that there is no theoretical limit to the temperatures attainable in the nuclear rocket, so that its ultimate performance will depend on methods and material of construction and the manner in which the heat is released in the working fluid.

Another form of propulsion which has attracted the attention of space enthusiasts for many years, and now shows promise of appearing in a practical form, is the ion rocket. In this device the propulsive jet consists of a beam of charged particles which are accelerated by an electric field, and not by pressure forces as in the more conventional thermodynamic rocket. Exhaust velocities as high as 300,000 ft./sec. may be attainable, and the significance of such an increase in performance over chemical rockets, which currently operate with exhaust velocities of around 7,000 ft./sec., scarcely needs stressing.

However, a limitation of ion-rocket systems so far conceived is that the weight of the machinery to produce the accelerating electric field is high in relation to the thrust produced. Provided this can be reduced to a reasonable value, however, this form of propulsion may well prove the means for accelerating Earth satellite vehicles out of their orbits and along their journey into space. In this application it is interesting to compute that, if fitted with an ion rocket having the performance indicated above, a vehicle weighing 2,000 lb. would expend only a further 70 lb. of propellent in accelerating from an orbiting speed of 18,000 m.p.h. to the escape speed of 25,000 m.p.h.

Preliminary studies made so far indicate that an acceleration of 10^{-4} *g* might be obtainable in practice. If this figure is assumed, then the thrust produced would be only 0.2 lb. and the acceleration period would last 36 days. This would cause some concern in the case of manned vehicles, but would be of little consequence for their unmanned predecessors.

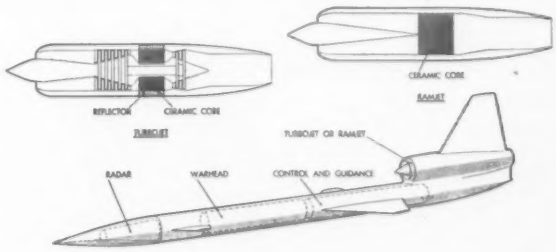
If a particular reactor system appears attractive as the result of the preliminary design studies then the next stage in its development is to carry out tests on all the vital reactor components under simulated operating conditions. This approach is paralleled in the aeronautical field by the construction of special compressor and turbine test rigs to check the performance of these vital components prior to the construction of a prototype turbojet engine.

In the case of the reactor development the preliminary engineering tests on components and circuits can be conveniently sub-divided into two categories referred to as "in-pile" and "out-of-pile." In the former case the experimental equipment is inserted in a research reactor so that the effect of nuclear radiations can be determined, whereas for the latter tests the more normal engineering techniques and facilities are adequate (e.g., the measurement of heat transfer and pressure drop characteristics of new fuel element designs).

A typical example of an in-pile engineering experiment is the closed-circuit or "loop" now being designed by the de Havilland Engine Company's Nuclear Power Group in collaboration with the A.E.R.E. for testing a new type of ceramic fuel element. It is intended that this should allow a significant increase in reactor operating temperatures, and hence result in higher specific heat outputs and an improved thermal efficiency in the powerplant cycle. Furthermore, since primary coolant temperatures as high as 800° C. are considered entirely feasible, it is possible to give serious consideration to the possibility of using gas turbines to convert the nuclear heat into useful power or, in the special case of the turbojet, propulsive thrust.

Conclusions

The use of nuclear propulsion for aircraft appears to be technically feasible but a vast programme of research and testing would be required to produce a reactor of acceptable weight and standard of reliability. Even if this goal is achieved there remains the problem of ensuring that no excessive radiation hazard will exist in the event of an accident and it is very difficult to envisage systems in which there is not some risk of



A possible arrangement of powerplant for a nuclear-propelled missile. Both turbojet and ramjet versions would employ a ceramic-type reactor core. An operating temperature of 1,000° C. would be adequate for a turbojet, but 2,000° C. is essential to obtain reasonable performance with the ramjet.

fission products escaping if the reactor strikes the ground at its terminal velocity.

The success of the United States Navy submarine *Nautilus* leaves little doubt that practically all large naval vessels of the future will be powered by some form of nuclear powerplant. The application to merchant shipping seems certain to follow once the new reactors are proven and operating costs become strictly competitive with oil-burning engines.

The widespread use of transportable power stations awaits the development of a small inherently safe, automatically-controlled reactor system requiring only two or three staff to supervise operation. The fuel elements must be capable of operating continuously for a period of at least one year before replacement becomes necessary and centralized fuel element reprocessing plant must be provided to service several reactors if operating costs are to be held at a reasonable level.

THE FIGHTING SERVICES

Royal Visit

H.R.H. THE DUCHESS OF GLOUCESTER, Air Chief Commandant of the W.R.A.F., will visit R.A.F. Hawkinge on February 18 to attend the passing-out parade of the 44th intake of the W.R.A.F. Officer Cadet Training Unit. On arrival, Her Royal Highness will be met by the A.O.C.-in-C. Technical Training Command, Air Marshal A. W. B. McDonald, the A.O.C. No. 22 Group, Air Vice-Marshal R. Faville, and Air Cdt. M. H. Barnett, Director of the W.R.A.F.

Mapping of Aden Completed

VALIANTS and Canberras of Bomber Command, in co-operation with M.E.A.F. Canberras, have completed the aerial photography of the entire Aden Colony and Protectorate —some 112,000 square miles—for the Colonial Office and the Directorate of Military Survey. Started by Meteor P.R.10s of No. 13 Squadron, M.E.A.F., which continued in the task after re-equipping with Canberra P.R.7s in 1956, the survey was aided by preliminary photographs taken by No. 543 Squadron Valiants, and Canberra P.R.7s of No. 58 Squadron.

Flown from R.A.F. Khormaksar, the photographic sorties will bring up to date the existing maps of the area, which lack detail and incorporate errors of up to 10 miles. No ground aids were available and photography was started from the coast, progressing inland on parallel courses. As the task got under way photographs taken on previous sorties were used as maps to start further parallel courses in the uncharted interior. Weather hampered operations, and sorties could be flown only from September to April; sand haze and thick cloud prevented good photography during the remainder of the year.

The resulting mosaics were laid down and checked for quality and 100% coverage by members of a Radar Aerial Survey Liaison Section, Royal Engineers. Because normal triangulation was impossible in the Protectorate's wadi-strewn and mountainous terrain, field units took astronomical observations to establish map scales. Each Canberra sortie, flown at 40,000 ft., produced mosaics covering 150 square miles for half-inch and quarter-inch maps.

No. 38 Group Presentation

IN MEMORY of its members who fell in the 1939-45 War, No. 38 Group Old Comrades Association (Airborne Forces) is to give a silver chalice and paten to St. Clement Danes, the Church of the R.A.F. The presentation of the gifts to the Chaplain-in-Chief, the Rev. Canon A. S. Giles, will be made by Air Chief Marshal Sir Leslie Hollinghurst, president of the Association, in the crypt of the church at 17.00 hrs. on March 8.

The Group, which has already made a substantial contribution to the church rebuilding fund, played an important part in landing airborne troops in Sicily, Normandy and other parts of Europe. The Association was formed in 1946 of personnel attached to the former No. 38 Group stations of Hurn, Harwell and Rivenhall. In 1955 a stone and plaque were unveiled at Harwell on the spot where the first aircraft with airborne troops took off for the main assault in the Normandy beach-heads on June 5, 1944.

Admiral of the (Light) Blue

AS a tribute to one of its founders in 1932, the R.A.F. Yacht Club has made Air Chief Marshal Sir Frederick Bowhill, G.B.E., K.C.B., C.M.G., D.S.O., Admiral of the Club. A.O.C.-in-C., Coastal Command, between 1937-41, Sir Frederick went to sea from H.M.S. "Worcester" at the age of 16 and began flying in 1912. His Service career, starting in the Naval Wing of the R.F.C., took him through the R.N.A.S. to the R.A.F.

In addition to commemorating its 25th anniversary in this way, the R.A.F. Yacht Club had a successful season, finishing sixth out of 49 clubs in the Royal Ocean Racing Club's points list. It must be added, however, that most of the points were won by Major D. Maw, M.C., sailing his ocean racer "Bluejacket" under the club's burgee.

Royal Air Force Appointments

THE following are among recent Royal Air Force appointments:—

Group Captains: G. Gilchrist to Headquarters, 22 Group, as Senior Medical Officer; P. A. Lee to Royal Air Force Hospital, Weeton, to command and as Senior Medical Officer.

Wing Commanders: W. C. Baird to Royal Air Force Hospital, Cosford, as specialist in medicine; A. D. Balmain to Headquarters, Bomber Command, for technical staff duties; E. J. Brooks, D.F.C., to Royal Air Force West Raynham, as Station Commander; A. Brown, D.F.C., to Headquarters, Fying Training Command, for air staff duties; R. Brown, M.B.E., D.F.M., to Royal Air Force Wittering, to command the Bomber Command Armament School; H. D. Clark to Royal Air Force Aston Down, to command No. 20 Maintenance Unit; A. S. Duff, O.B.E., to Air Ministry, for duty in the Department of the Air Member for Supply and Organization; H. Durkin, to Air Ministry for duty in the Department of the Air Member for Supply and Organization; W. J. F. Fenton, to No. 2 Movements Unit, to command; D. S. Grant to Air Ministry for duty in the Directorate General of Medical Services; C. G. Harold, to Headquarters, 64 Group, as Deputy Senior Medical Officer; C. G. St. D. Jeffries, D.F.C., as Officer Commanding Flying, Royal Air Force Binbrook (not to Royal Air Force Lynham, as previously stated); P. Peters, O.B.E., D.F.C., to Royal Air Force Northolt, as Officer Commanding, Flying Wing; M. O. Richardson to Headquarters, 25 Group, as Senior Medical Officer (and Senior Medical Officer at Royal Air Force Manby); D. F. Rixon, O.B.E., D.F.C., to Royal Air Force Dishforth, to command the Transport Command Examining Unit; D. C. H. Simmons, A.F.C., to Royal Air Force Staff College, Bracknell for directing staff duties; W. D. Symes to Royal Air Force Bruggen to command; W. G. Welch to Air Ministry for duty in the Department of the Air Member for Supply and Organization; J. C. Wickham, O.B.E., to Allied Air Forces, Central Europe, for staff duties; A. R. Wright, D.F.C., A.F.C., to Royal Air Force Waterbeach as Officer Commanding, Flying Wing.

Squadron Leaders: G. E. H. Hackman, A.F.C., to Royal Air Force Wilmslow as Officer Commanding Training Wing (with acting rank of Wg. Cdr.); S. Kirtley to Royal Air Force Wildenrath for administrative duties (with acting rank of Wg. Cdr.).

SNOW EQUIPMENT.—An Auster A.O.P.6 fitted with Auster-designed retractable skis, which can be seen in the retracted position with the wheels protruding through the bottom surfaces. Of metal construction with a Bakelite under-skin to stop freezing on contact with the snow, the skis are mechanically lowered into position by a single cockpit lever.

The Captains and their Wings Depart

Royal Navy training ends at R.A.F. Station Valley

THE LAST of the naval pilots to receive their wings at R.A.F. Valley departed recently in their Vampires for their new home at Linton, Yorks, singly and in pairs as the snow-bound runways permitted, thus bringing to a close three years of the most happy and profitable co-operation between the Royal Air Force and the Royal Navy at No. 7 F.T.S. in Anglesey, North Wales.

During this period, 225 R.N. student pilots have done the final stage of their flying training at this Master Diversion Airfield, and gone on to R.N.A.S. Lossiemouth for fighter instruction on Sea Hawks or anti-submarine training on Gannets at Eglinton, both of which stations have always been purely Naval commitments.

At Valley the organization has always been similar to the other R.A.F. training schools, with the addition of a Senior Naval Liaison Officer and his naval training staff. Also, about a third of the qualified flying instructors (Q.F.I.s) were Naval officers on exchange posting to the R.A.F. and the chief ground instructor and his staff were mostly Naval, too, as the R.N. student pilot has a somewhat more intensive ground syllabus which includes specialist Naval subjects.

When last year it was decided to cut the Auxiliary Services and the R.N.V.R. air squadrons went out of existence the numbers on the courses, which had included National Service pilots, were drastically reduced, and it was no longer an economic proposition to maintain two R.A.F. flying schools for this purpose, a basic Provost stage at Syerston and the advanced stage at Valley. As do their R.A.F. counterparts, naval pilots complete about 120 hr. on the Provost and 100 hr. on the Vampire, but they do so in somewhat shorter time, 14 months as opposed to 18 months. The final outcome is that No. 7 F.T.S., which for most of its existence has been engaged in training pilots for the Fleet Air Arm, now virtually loses its identity, and No. 1 F.T.S. takes over the joint rôle of both basic and advanced instruction on one aerodrome at Linton.

This will be a new experiment in pilot training, and if it proves successful with the relatively small numbers involved, may well be extended to the other pairs of training stations in Flying Training Command, with great benefits in organization, administration and economy. For some time now, cadets undergoing training at the R.A.F. College at Cranwell have undertaken both basic and advanced stages under joint control, but in this case a satellite airfield at Barkeston Heath has been used in addition to the main airfield at Cranwell itself. The operation of piston-powered Provosts and jet-propelled Vampires from one field for training will be entirely new, however, and a satellite will be employed solely for emergencies and for the intensive period of circuits and bumps after first solos.

The final passing-out parade of Fleet Entry Lieutenants* comprising No. 64 R.N. Course was reviewed by Rear Admiral A. S. Bolt, D.S.O., D.S.C. and Bar, Deputy Controller of Aircraft, who had comforting words for the graduates and their parents. He prophesied that newspaper reports of the early termination of piloted flight were false and that the White Paper to appear in February would reveal that the new manned aircraft coming into naval service during the next four or five years would keep everybody in the F.A.A. fully employed; and would add enormously to the punch and power of our Fleet.

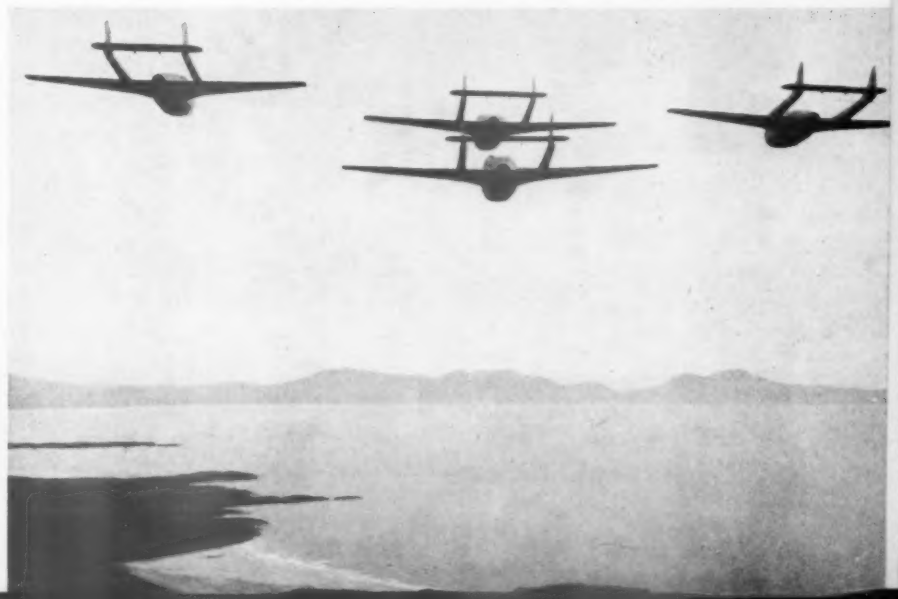
In typical fashion, the Navy had a final outstanding achievement to mark its departure from Valley. Midshipman Robert Faulkener, one of the last pilots undergoing training on a short-service commission, collected all three prizes for the first time, the Alvey Trophy for best results in the air, the Goldcrest Shield for top marks in the Ground School and the Wragg Trophy for the best overall results.

Rear Admiral A. S. Bolt, D.S.O., D.S.C. and Bar, the reviewing officer for No. 64 R.N. Pilots Course, presents one of the three trophies won by Midshipman Robert Faulkener. On the left is the Valley Station Commander, Gp. Capt. J. T. Shaw, D.S.O., D.F.C., A.F.C.

It says much for the quality of instructors and pupils alike that not one culpable flying accident has been recorded during the whole period of naval training at No. 7 F.T.S. at Valley, coming top of all the F.T.S.s in this respect despite the somewhat more intensive flying programme. The final ground examination results have always been well above the average.

JOHN REID.

* The Admiralty now treats flying as a specialist subject for executive officers, as with gunnery, navigation, etc.; flying training is usually done after two years or so at sea and obtaining a watchkeeping certificate.



MORNING DEPARTURE.—Four D.H Vampire T.11s of No. 7 F.T.S. leaving Anglesey for the last time on their way to No. 1 F.T.S., Linton-on-Ouse, Yorkshire. They are piloted by two R.N. and two R.A.F. Q.F.I.s. The mountains of the Nevin peninsula are in the background.

Helicopter versus Submarine

WITH No. 845 Squadron (Lieut. Cdr. M. Hayes, R.N.) on board H.M.S. "Bulwark" for the carrier's World cruise to the West Indies and the Far East by way of Gibraltar, and a second squadron—No. 820—formed at Eglinton, the rôle of carrier-borne helicopter squadrons for anti-submarine duties is now established in the Royal Navy. Operating Westland Whirlwind H.A.S.7s equipped with Sonar gear—the first British helicopter designed specifically for the task—the Fleet Air Arm has added another important weapon to the battle against the submarine.

A development of earlier marks of Whirlwind, the H.A.S.7, powered by one Alvis Leonides Major 14-cylinder air-cooled supercharged two-row radial engine, has a number of structural changes from the original aircraft. The actual anti-submarine equipment and weapon are surrounded by the normal cloak of security and these installations and their tactical deployment are, therefore, restricted, although a certain amount of information can be deduced from the facts that can be released.

The Sonar gear is of American design and manufacture, and has been used by the United States Navy in its S-55s for some years. It consists of a transducer unit which is lowered into the water from the hovering helicopter by means of an electrical winch, known in the Navy as "dipping the Asdic," and a receiver in the cabin.

Controlled by a rating operator, the Sonar gear supplies position information of an enemy submarine in a similar manner to the standard Asdic fitted in surface vessels, which is plotted by an F.A.A. observer who has received anti-submarine training at H.M.S. "Vernon" and other shore establishments. This information is in the form of a distance and bearing, and with accurate knowledge of the Whirlwind's position a plot of the submarine's track can be obtained.

Due to the weight and size of the Sonar gear and the anti-submarine weapon, which is in the form of a homing torpedo, only one of the two units making up the complete weapon system can be carried by a Whirlwind. This means that at least two aircraft are required to hunt-out and attack a submarine.

As the first production mark of Whirlwind to be powered by a Leonides Major engine, coupled with its structural alterations, the H.A.S.7 required C. of A. clearance by the Ministry of Supply, and a Helicopter Flight of No. 700 Squadron, under the command of Lieut. Cdr. J. S. Sproule, R.N., was formed on March 18, 1957, to undertake intensive flying trials. These started at Yeovil with a target of 200 flying hours on each of the Flight's four Whirlwinds and were later transferred to R.N.A.S. Lee-on-Solent.

The Alvis Leonides Major powerplant installation in the Westland Whirlwind H.A.S.7, which has been de-rated to 750 b.h.p. Fitted with a Plessey cartridge starter, the engine has a low-pressure fuel-injection system eliminating the manual mixture control.

Photograph copyright "The Aeroplane"

The object of the trials was to uncover the normal crop of minor snags which are found with all types of new aircraft and the flying pattern was designed in conjunction with A. and A.E.E., Boscombe Down, to simulate the operational rôle of the H.A.S.7. This meant that a high proportion of the hours flown during the period of the trials was spent in hovering, when a number of engine problems came to light. The Whirlwinds were at all times flown at the operational weight of 7,800 lb.

Left, anti-submarine Whirlwinds of No. 845 Squadron, F.A.A. (Lieut. Cdr. M. Hayes, R.N.), on board H.M.S. "Bulwark" which is going on a World cruise to the West Indies and Singapore. Below, a rear view of an H.A.S.7 showing the radar reflectors on the main undercarriage legs and the horizontal aerodynamic stabilizers.

Photograph copyright "The Aeroplane"

A ground-to-air view of the H.A.S.7 hovering, the anti-submarine weapon bay in the lower fuselage structure and the cap covering the Leonides Major cartridge starter can be seen. A step has also been fitted on the starboard side because of the raising of the height of the cabin floor.

Consisting of the C.O., Lieut. Cdr. Sproule, three pilots, led by Lieut. Cdr. D. J. Chaplin, a torpedo anti-submarine officer, an observer and two technical officers, plus technical representatives from the two companies, the Flight completed its task with a total of 750 hr. in five months and was disbanded in October, 1957. Cold-weather trials are now in progress in Canada, but the Whirlwind H.A.S.7 has not yet undergone tropical flying tests.

Operational Service

Before the short life of No. 700 H Flight came to an end the first operational anti-submarine squadron—No. 845—was formed and equipped with H.A.S.7s. Commanded by Lieut. Cdr. M. Hayes, R.N., No. 845 Squadron worked up at Lee-on-Solent and embarked on the carrier "Bulwark" in October to take part in the autumn NATO exercises in the North-east Atlantic. The Squadron then returned to Lee-on-Solent at the end of last year for further training before re-embarking on January 10 for the World cruise by the "Bulwark."

All of the operational trials with the Sonar gear and anti-submarine weapon were made by No. 845 Squadron during its original training period, and the tactical deployment of the H.A.S.7 was developed. By using a number of aircraft, say two or three, in the submarine-detection rôle at any one time the carrier commander could have a continuous watch kept on the sea area around his position. To help in plotting and identification of these helicopters by radar, two rear-facing reflectors are fitted on the main undercarriage legs.

The minimum weather limitation for anti-submarine work is obviously higher than for normal helicopter flying, and if it becomes impossible to keep the transducer in the water directly below the aircraft the accuracy of the Sonar gear is lowered.

Structural Changes

Apart from the installation of the Leonides Major powerplant, the main differences of the H.A.S.7 over the earlier marks of Whirlwind are in the fuselage. The cabin floor level has been raised by 6 in. to sink the anti-submarine weapon into the fuselage lower structure, and the fuel tanks have been divided into two banks of three by the weapon bay. The total fuel capacity having been increased to 170 gal.

The overall depth and ground clearance of the fuselage are unchanged, but because of the raising of the height of the cabin floor a foot step has been added below the main door on the starboard side. On the H.A.S.7 the hydraulically powered hoist with a jib mounting above the cabin door has been redesigned as a self-contained "package" unit which can be fitted when the helicopter is used in the search-and-rescue and other rôles, such as troop-carrying.

As it is not possible, due to weight limitations, to carry a standard winch when the Whirlwind is fully equipped for its anti-submarine work, a "heave ho" type of unit weighing 10 lb. has been developed by the Helicopter Flight of No. 700 Squadron in conjunction with Westland. Using manual power, this winch is capable of lifting aircrew from the sea.

The cockpit layout with the pilot's seat to starboard. A cyclic-pitch control column and rudder pedals are installed in the conventional manner, along with a collective-pitch lever to the left of the seat incorporating a twist-grip throttle.

Photograph copyright "The Aeroplane"

To remove the possibility of the all-metal main rotor blades touching the tail cone when they are hard down on the droop stops, the complete tail cone aft of the main fuselage has been lowered 3°, so the overall ground clearance of the tail rotor head has been reduced by approximately 1 ft. to 4 ft. 3 in. The two aerodynamic stabilizers which are in the drooped position on the earlier marks have also been raised to the horizontal and are fixed without any anhedral.

Changes brought about by the installation of the Leonides Major engine include the use of a Plessey cartridge starter, the mounting of the D.C. generator on the powerplant and replacing the 12-in.-diameter Delaney Gallay oil cooler with a 14-in.-diameter unit.

Performance Figures

Operating at a maximum all-up weight of 7,800 lb. and using the 750-b.h.p. de-rated Leonides Major at 1-hr. continuous power setting, the H.A.S.7 has a hover ceiling in free air of 5,500 ft., and 8,500 ft. with ground cushioning. Its best vertical rate of climb at sea level is 1,250 ft./min. and the service ceiling 14,000 ft. Cruising at a T.A.S. of 75 knots, its maximum still-air range with full fuel (170 gal.) is 340 n.m. Equipped with Sonar gear, the range is reduced to the order of 200 n.m., although endurance is the main factor for this rôle.—P.R.R.

Astronautics

Tracking the Red Moons

Radio Observations of the Russian Earth Satellites at the Mullard Radio Astronomy Observatory, Cambridge, described by G. R. WHITFIELD.

WHEN the news of the launching of the first Earth satellite was received on October 5, it was at once decided by the staff of the Mullard Radio Astronomy Observatory to make radio observations of its position. Preliminary observations were made on the night of October 5-6, using an aerial system and receiver normally used for the study of radio stars. The following day a more suitable aerial system was constructed, and observations were continued until the satellite ceased to transmit three weeks later.

Most of the observations made use of the 40 Mc/s. transmissions from the satellite, to minimize the effect of the ionosphere; but later observations were made at 20 Mc/s., to give information about the structure of the ionosphere, and at 80 Mc/s. (using the first harmonic of the satellite's 40 Mc/s. transmission) to reduce ionospheric effects still further.

Besides our own observations, we have been able to use valuable recordings made by G.P.O. receiving stations,

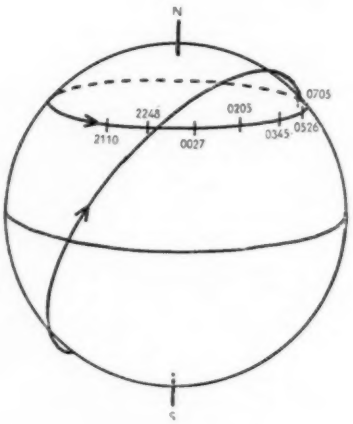


Fig. 1. Orbit of first satellite, showing the path of Cambridge under the orbit. The times show the approximate position of Cambridge during the successive transits.

members of the Radio Section of the British Astronomical Association, and others, for whose co-operation we are most grateful.

The orbit of the first satellite, deduced from these observations, is shown in Fig. 1. Six or seven transits were observed each night, at about the times given. It was convenient that the period of the satellite was almost exactly 1/15 of 24 hr., so that the times of corresponding transits changed little from day to day.

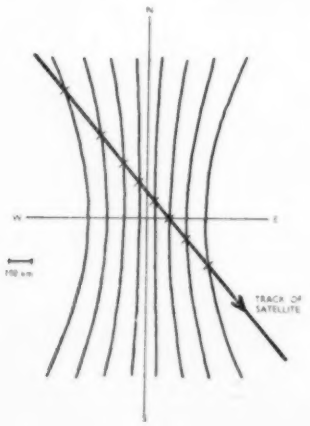


Fig. 2. Interference pattern at a height of 530 km., showing the derivation of a track relative to Cambridge.

The Observational Methods

The principal instrument used was an interferometer consisting of two simple aerials (full-wave dipoles), four wavelengths apart on an east-west line, connected to a receiver whose

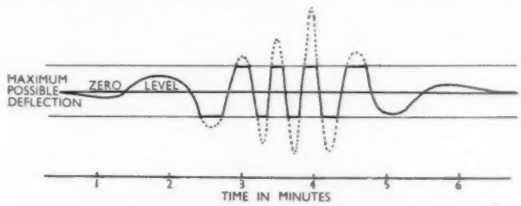


Fig. 3. Typical record obtained from the interferometer. The times for which the trace crosses the zero line give the times at which the satellite crossed the hyperbolæ in Fig. 2.

output was recorded continuously on a moving chart. The interference pattern of such an aerial system cuts a horizontal plane in a series of hyperbolæ (Fig. 2), whose form depends on the height of the plane above the Earth, and an oscillating record (Fig. 3) was drawn as the satellite passed across them. When the satellite passed near Cambridge this instrument gave the position, height and time at which it crossed the meridian.

The other method used was to measure the change in the apparent frequency of the satellite's transmission as it passed; this change—the Doppler effect—is due to the changing of the component of the satellite's velocity towards the observer. The maximum rate of change of frequency occurs at the time of closest approach of the satellite, and from the steepness of

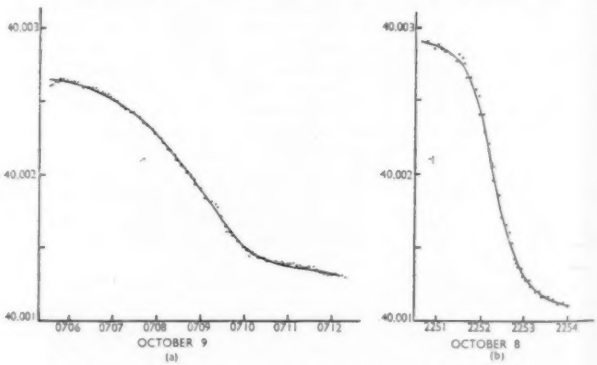


Fig. 4. Variation of received frequency with time for tracks having slant ranges of (a) 1,200 km. and (b) 310 km.

the curve at this point the "slant range" of the satellite can be deduced. Typical curves are shown in Fig. 4 for two different ranges.

The Orbit of the First Satellite

The details of the orbit were found by a method of successive approximations. First, the orbit was assumed to be circular, and the height and velocity of the satellite were calculated from the measured period. Then the interferometer and Doppler measurements made during the middle of the night were used to find the distance of the satellite north of Cambridge at its most northerly point; this gave the inclination of the orbit to

Fig. 5. Derivation of track of satellite from slant ranges measured by the G.P.O. Station, Baldock, on three successive transits. B1, B2 and B3 are the projected positions of Baldock for the three transits.

the equator, from which could be found the angle at which the track of the satellite crossed the latitude of Cambridge.

Attention was then concentrated on the close transits, near 22.50 hrs. and 07.00 hrs. At these transits, the interferometer measurements gave the height and position of the track of the satellite. An independent measurement of these quantities can be obtained by triangulation of the slant ranges obtained from Doppler measurements made at a number of stations, and by one station at successive transits (Fig. 5).

These measurements were sufficient to give the details of the orbit (Table 1), from which predictions of the future

TABLE 1.—Provisional details of the orbits of the Russian Satellites.

	First Satellite on Oct. 15	Second Satellite on Nov. 6
Inclination to the Equator	64°40′±10′	65°10′±15′
Period	hr. min. sec. sec. 1 35 50.0±0.3	hr. min. sec. sec. 1 43 37.2±0.5
Rate of decrease of period	2.2±0.1 sec./day	3.1±0.2 sec./day
Height at latitude 52°12′		
on northward passage ..	223±10 km.	220±10 km.
on southward passage ..	470±15 km.	600±50 km.
Height above mean Earth		
at perigee	197±10 km.	205±10 km.
at apogee	934±10 km.	1655±10 km.
Latitude of perigee	36°N±3°	47°N±3°
Longitude of ascending node ..	308°09′±15′	106°48′±30′
Retrograde motion of ascending node	3.1°±0.1° per day	2.6°±0.5° per day
Meridian passage at Cambridge ..	day hr. min. sec. Oct. 15 21 08 41 U.T.	day hr. min. sec. Nov. 6 06 38 00 U.T.

position of the satellite could be made. But, since 15 periods was almost exactly 24 hr., good local predictions could be made by extrapolating the observations of particular transits made on successive days. By this means we were able to predict transits over the British Isles one or two days in advance, with an accuracy of about 50 km. in track, 10 km. in height and 3 sec. in time of meridian transit.

Changes in the Orbit

The orbit was found to be precessing westwards about the Earth's axis at a rate of 3.1°/day. This is caused by the flattening of the Earth at the poles, and agrees very well with what was expected.

In addition, the period decreased (Fig. 6) and the rate of decrease was used to give an estimate of the air drag on the satellite, and hence of the air density. Using the published mass of 84 kg., and assuming that gas molecules which hit the satellite adhere to the surface and then leave with random velocities, it was estimated that the mass of air encountered in one period was 1.8 gm.

Because the orbit was elliptical, the density could only be calculated if the change of density with height were known, and this depended on the temperature. Assuming a temperature of 1,000° C., the density at a height of 200 km. was found to be about 4×10^{-13} gm./cm.^{3}, or 3×10^{-10} of the density at sea-level. This was somewhat higher than the accepted value of 1.7×10^{-13} gm./cm.^{3}, derived from rocket observations. But it is probable that the satellite, which travelled through the ionized layers of the atmosphere, acquired an electric charge which could appreciably increase the air drag by attracting ions to the satellite's surface. Since this effect has been neglected, the value obtained for the air density would be expected to be too high.

The Second Satellite

This has been observed in the same manner as the first, but in addition optical observations have been possible. A satellite is only visible just before dawn or after sunset, when the sky is dark, and the satellite is in the sunlight; but the first satellite was too small to be easily observed even then. The second satellite has been seen many times, as a bright moving point of light, in the early morning.

The orbit (Table 1) is similar to that of the first satellite, but the mean height is greater, giving a longer period; and the

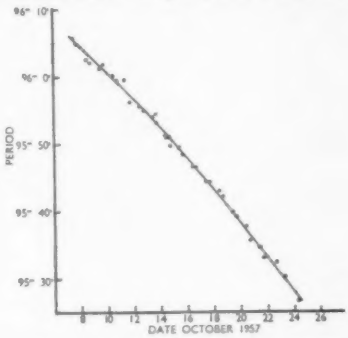


Fig. 6. Graph showing change of period of the first satellite.

orientation of the orbit relative to the Sun is different, the satellite being observable from before dawn to mid-afternoon, instead of during the night.

Conclusions

The first two satellites have provided useful information about the density of the upper atmosphere, and continued observation of the second by radar and optical methods should give measurements of density and temperature over a wide range of heights. In addition, the presence of the satellite transmitters at varying heights and positions has made possible several new methods of ionospheric investigation. So far only preliminary observations have been made, but the results are encouraging, for measurements can be made of the upper part of the ionosphere which cannot be reached by conventional radio-pulse methods.

Clouds in Film Strips

GONE are the days when an aviator was considered knowledgeable about clouds if he could call the 10 principal types by their names. Nowadays it is considered necessary to know what the air is doing in order to produce them, and for some years this information has been pouring out of the Meteorological Department of Imperial College, much of it through Mr. F. H. Ludlam and Dr. R. S. Scorer, whose ideas have been stimulated by their discussions with sailplane pilots.

These two experts have now collected about 50 excellent colour photographs of clouds, covering a large range of types, and produced them in the form of film strips suitable for lectures. They were shown in public for the first time at the Kronfeld Club on January 29, with Dr. Scorer to explain them.

They certainly are a magnificent collection, and show the advantage of photographing clouds in colour, because one can distinguish between the blue sky and the darker shades of the clouds, which cannot always be done in black-and-white photographs. As is usual with reproductions, they are more contrasty than the originals but, though this makes them look less natural, it shows up fine details of cloud structure to advantage.

Two strips are available, the first showing cumulus, cumulonimbus, ice clouds and haze layers. The clouds range from a small cumulus formed as early as 06.00 hrs. over a sun-facing slope in Yorkshire, to a cirrus in which, in spite of its brightness, the ice crystals must, Dr. Scorer said, have been as much as a foot apart and would hardly be noticed by anyone flying through them. The second strip shows layer clouds, billow clouds (which move with the wind) and wave clouds (which don't).

The film strips are marketed by Diana Wyllie, Ltd., of 18 Pont Street, London, S.W.1, and are accompanied by a descriptive pamphlet for the use of lecturers, in which pamphlet only an elementary knowledge of physics is assumed. The strips are made in both single-frame and double-frame size, and the larger size can be cut up to make separate slides.—A.E.S.

More on Guided Flight

Last week we gave a brief summary of some of the points discussed by Mr. L. H. Bedford, C.B.E., M.A., B.Sc., chief engineer of English Electric's Guided Weapons Division, in his lecture to the R.Ae.S. Guided Flight Section on January 23. Here KENTIGERN *concludes his summary of the lecture and gives an account of the discussion which followed.*

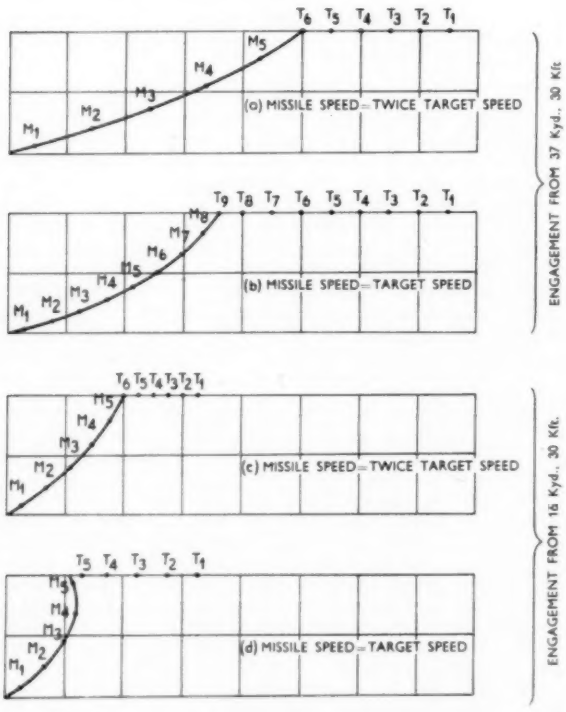
FOLLOWING his detailed discussion of the beam-riding system (which was summarized in THE AEROPLANE for January 31), Mr. Bedford turned his attention to the "command" system of guidance.

In the command system the positions of the target and the missile were each followed by a radar tracker, the interception course was found by a computer, and orders for lateral acceleration were passed to the missile by a command link radio. It had the advantage that the missile was simple and received strong signals and that the complication was on the ground, but it had the disadvantage that the small vector required, the miss distance, was the difference of two large vectors.

Nevertheless, this was the first ground-to-air system to reach deployment in the United States. It might be said, perhaps, that only in the United States, and at the Bell Laboratories, could the detail accuracy have been achieved.

Homing systems had the great advantage that the angular position of the target was measured from the missile so that accuracy increased as range decreased and small miss distances could be achieved. In the active system the missile carried a radar transmitter and receiver; and in the semi-active system the missile carried only the receiver, and homed on the echo from a ground transmitter signal.

This greatly simplified the semi-active missile, and the system was further simplified if the missile were designed to home all the way, and so avoid the complication of directing the eye onto the target and locking on while in flight.


(a) MISSILE SPEED = TWICE TARGET SPEED
(b) MISSILE SPEED = TARGET SPEED
(c) MISSILE SPEED = TWICE TARGET SPEED
(d) MISSILE SPEED = TARGET SPEED
ENGAGEMENT FROM 37 Kyd., 30 Kft.
ENGAGEMENT FROM 16 Kyd., 30 Kft.

This diagram shown by Mr. Bedford illustrated the shape of collision-course paths followed by a beam-riding missile at various distances and altitudes (in kiloyards and kilofeet)—as discussed in our previous issue (page 133).

The fundamental equation (which the lecturer built up on the blackboard) is:—

$$P_r = P_t \frac{1}{4\pi R_1^2} G_t A_e \frac{1}{4\pi R_2^2} \times A_r$$

where P_r is power into receiver; P_t, power of transmitter; R_1, radius of transmission; G_t, ratio of actual power density on beam axis to density at uniform distribution; A_e, echoing area; R_2, target-to-missile distance; A_r, area of receiver dish; A_t, area of transmitter dish; λ, wavelength of system.

Whence, by steps which would be shown in the written paper:—

$$R_1^2 R_2^2 = \frac{1}{4\pi} \frac{P_t}{P_r} \frac{A_t A_e A_r}{\lambda^2}$$

in which P_t might be 10^5 watts; and P_r might be 10^{-12} watts; so that, $\frac{P_t}{P_r} = 10^{17}$ watts and on the launcher, R_1 might be 30 kilometres.

The limitations on the size of the transmitting aerial and on the transmitter power of the active system in a missile thus gave an advantage to the semi-active system.

The navigation system received the angle information on the location of the target and computed the course. In the proportional navigation system, the missile course was changed at a rate λ times the rate of change of angle of the sight line to the target. If $\lambda=1$, the missile did a pursuit course, and if $\lambda \rightarrow \omega$ the missile did a constant bearing collision course, and if λ is of the usual figure of about 3 or 4 the missile approached a collision course.

The control process was then shown by a block diagram built up on the blackboard. The basic simple system accepts guidance information as a rate of turn of the sight line to the target, the rate being passed to a navigation block which transformed this to the required proportional rate of turn of flight path, thence to the power controls block and the aerodynamic action (shown as another block for a reason given in a moment), giving a rate of turn of the missile and hence a rate of turn of the flight path, which was fed back to the required rate of turn mentioned at the beginning. The complications to be added to this ideal model were then shown, including two (or more) body-bending modes modifying the aerodynamic response, a rate-gyro to mark the rate of turn of the missile; and in the discussion at the end, the need for an accelerometer to limit the maximum acceleration to correspond with the structural strength was also stated.

The block diagram was convenient when arranging a simulator to check the action of the system. The practical difficulties, time and expense of flight trials were so great that all systems were first simulated as a quicker and cheaper method of making preliminary trials of their feasibility.

The simulator was organized from the block diagram of the system using electric "fudge units" to simulate the blocks when high-speed runs could be made or, alternatively, the simulator could be laid out to run at scale speed when actual missile parts could be used in the simulator system.

Firing trials of the missile were done in stages; after the first elementary firings, control rounds were tried in which the control system was used to maintain a straight path which could be varied by arranging step inputs to allow responses to be observed.

There were two ways of arranging the first trials of rounds with complete control and guidance. Rounds could be fired under control with the guidance head free to follow a target but not connected to the control; this was a "looker" round. Another method was to connect the guidance head to the

control from the first trial so that the whole homing system was used. The English Electric team's practice was to combine the two methods, the round was fired with the guidance head free initially and, after a set delay and length of flight, the guidance head was switched through to the control so that the round became a full homing round.

A film which followed showed five firings of the English Electric missile—first an early experimental firing, then two spectacular examples of unsuccessful rounds, and then a near miss of a target aeroplane at Aberporth, when the very fine achievement of the photographers there was seen. These rounds were fired without warheads and the near miss may have been within lethal distance.

Lastly, a firing at Woomera, in Australia, was shown and the uncut film, run at one-quarter of real speed, showed the whole flight of the missile as it climbed towards the Jindivik target drone which suddenly appeared in the picture and was struck and broken in parts.

Discussion Period

Mr. Bedford was asked a number of questions in an interesting informal discussion. Replying, he said that linearization of component parts was desirable when possible, and in the amplifier was largely forced by the feed-back system. With hydraulics which were not linear in behaviour and were difficult to simulate, actual parts should be used if possible.

Referring to the equation given for radar signal power, he said that the ratio of transmitter output to receiver input of 10^{17} given was for "visual" ranges.

If two targets were near together they would appear as a single target at long range and the missile would home on the pair. As the range shortened, the targets would appear to be separate and after a period of some oscillation the missile would select one and home on it. The need for this influenced the design at a number of points.

A system suggested for navigating by "maximizing" the rate of change of range has not been considered because range information was not usually available, and also a maximum was not generally a good limit for servos; a null point was desirable.

A suggestion that long time constants should be used at the beginning of flight, to be reduced as the missile neared the target, was agreed to be useful with the proviso that, as range was not known, the programme should change the time constant near the beginning of the flight. Such a system was in use with the navigation constant λ.

A New Napier Shaft Turbine

ANOTHER entrant to the small shaft-turbine field is the Napier Gazelle Junior which is, as its name implies, a scaled-down version of the Gazelle engine used to power the Westland Wessex and specified for the Bristol 192 helicopter.

The Gazelle Junior has an initial power rating of 920 s.h.p. which will be increased to 1,070 s.h.p. after early development running. It is available as a powerplant for both rotary- and fixed-wing aircraft and has been proposed as the result of a market survey which indicated the need for a British engine in this class, particularly for helicopters. A coupled version will be offered as a replacement for helicopters at present powered by a single piston engine.

The new shaft turbine has an axial compressor (presumably of 11 stages, like the Gazelle) driven by a two-stage turbine. Power is transmitted via a single-stage free turbine, the exhaust pipe bifurcating on both sides of the free-turbine shaft. An epicyclic reduction gear incorporating a hydraulic torquemeter transmits power from the free turbine to the engine output shaft. There are six combustion chambers.

Engine accessories including pressure and scavenge oil pumps, fuel pump and torquemeter pump are mounted around the compressor and driven by a separate gearbox from the compressor shaft. The accessories gearbox drive is also the drive from the starter and passes through one of the struts in the intake duct. Any form of starting may be used, but the first engines will have either iso-propyl nitrate (I.P.N.) or electric starting.

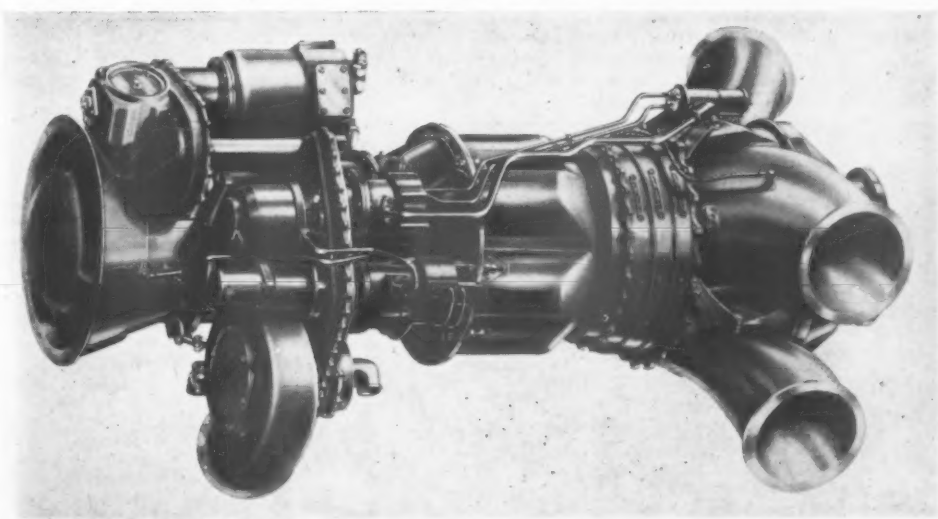
In helicopter installations the Gazelle Junior would normally be supplied with a Napier fuel-metering unit providing single-lever control and a number of safety devices. These include automatic compensation for variations in flight conditions and prevention of surge during rapid acceleration. There are also controls for engine overspeed, maximum turbine-inlet temperature and maximum torque.

In the event of a failure in the transmission system, a signal of low positive torque from the torquemeter automatically shuts the engine down and prevents overspeeding of the free turbine. If one engine of a coupled-unit powerplant fails, the power of the "live" engine is automatically increased sufficiently for the pilot to maintain controlled flight. All these control and safety features have already been satisfactorily developed on the Gazelle (which is now at 1,650 s.h.p. and will soon be producing 1,800 s.h.p.).

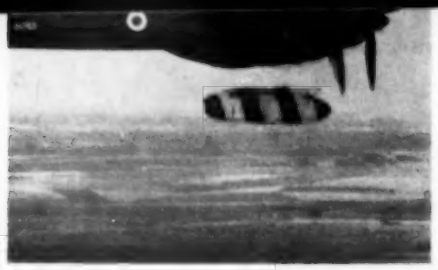
In turboprop form the Gazelle Junior has similarly comprehensive arrangements for fuel-metering, controls and safety devices. A drive is provided for an oil-cooling fan and a spare drive can be taken from the accessories gearbox. If required, provision can be made for de-icing of the engine air intake.

A lower reduction gear ratio is used in each unit of a coupled installation than is the case with a single engine, an additional reduction being provided by a gearbox common to both engines.

In early form the Gazelle Junior will have a one-hr. rating of 765 s.h.p. with a maximum continuous rating of 680 s.h.p. In developed form these ratings will be 900 s.h.p. and 800 s.h.p. respectively. Diameter and length of the engine are 33 in. and 54 in.; the basic weight is 495 lb. The engine can be mounted to run at any angle from vertical to horizontal, according to installation, and can have either left- or right-hand rotation to suit the rotor or propeller.



NEWEST NAPIER.—Bearing a strong likeness to its forbear, the Napier Gazelle Junior is a new shaft-turbine engine in the 1,000-s.h.p. class. A free power turbine is driven by a gas generator comprising a multi-stage axial compressor, six combustion chambers and a two-stage turbine.



Packaged Power for Take-off

WHEN the de Havilland Spectre variable-thrust rocket engine was described (THE AEROPLANE, August 23, 1957) we surmised that a fixed-thrust version might well be under development for the Avro Vulcan and Handley Page Victor V-bombers as an assisted take-off unit, bearing in mind that the D.H. Super Sprite rocket is used for this purpose with the Vickers Valiant. This conjecture has now been confirmed although full performance details are not yet released.

As in the case of the Valiant rockets, the Spectres for the Vulcan and Victor are carried in two jettisonable pods under the wings, between the engines. The pods for the two later V-bombers are similar, but have different attachments.

Each pod houses a Spectre engine complete with tanks for oxidant and fuel. The pod structure is of riveted light-alloy construction (mainly L.72). There is a basic floor above which are mounted tanks, engine and recovery parachute and below which is contained the air-bag used for cushioning impact with the ground after jettisoning.

Immediately behind the spun nose-cap of the pod is the large oxidant-tank compartment. This bay has an inner metal skin to provide smooth boundaries for the polythene bag-tank containing the hydrogen peroxide oxidant. This tank is filled via the removable nose-cap, and a polythene supply pipe passes through the bulkhead at the rear to feed the engine.

Aft of this bay is strapped the small kerosene tank—the ratio of hydrogen peroxide to kerosene used is about 9 : 1—and four attendant nitrogen bottles which pressurize both fuel and oxidant tanks, thus supplying back-up pressure to the propellent pumps. The 3,000-p.s.i. pressure is reduced to 15 p.s.i. for this purpose. Above the fuel tank is the parachute compartment which, in production units, houses a glass-fibre pack containing a 36-ft. diameter G.Q. parachute of blank-gore type, its 4-ft. diameter vane-type pilot canopy, and an M.L. Aviation extractor gun.

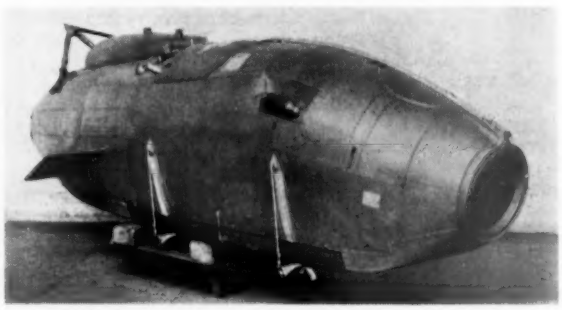
A substantial bulkhead behind the fuel tank provides the engine mounting points in the form of two side trunnions and a tie-link at the top. The Spectre is canted down at an angle and exhausts through an orifice in the rear of the pod. Below the floor in a central compartment is the air-bag which is enclosed by plywood doors. These doors are painted with Nutracote, a finish which is not affected by hydrogen peroxide. It is for this reason, incidentally, that the air-bag and the slinging ropes are of Terylene rather than nylon.

As the pod is nose-light when oxidant and fuel are exhausted, and because the aerodynamic centre of pressure is well forward, it is necessary to adopt a simple means of ensuring a "clean" jettisoning procedure. This is done, as it is also for the Super Sprite pods of the Valiant, by using small deflector vanes on each side of the nose. By giving these a negative angle of incidence the pod nose is pushed down on jettisoning.

Inspection of the engine shows that it is a simplified form of the variable-thrust Spectre. The latest fixed-thrust version yet revealed is the D.Spe.4 and it can safely be assumed that this is the unit used, the thrust presumably being about 8,000 lb as was estimated for the variable-thrust unit. Short-period operation means that a very simple oil system can be used with no provision for negative-g conditions or for operation at great heights. Thus a very small sump is fitted and it appears that there is no gear-pump at the base, indicating a simpler means of oil dispersal.

Compared with the variable-thrust Spectre seen before, the assisted take-off unit has much simpler accessories. Propellent pumps are smaller and set closer in to the basic gearbox and backbone of the engine. The valves are evidently arranged to be controlled by porting and a Western Manufacturing (Reading), Ltd., electric actuator operates the main engine controls.

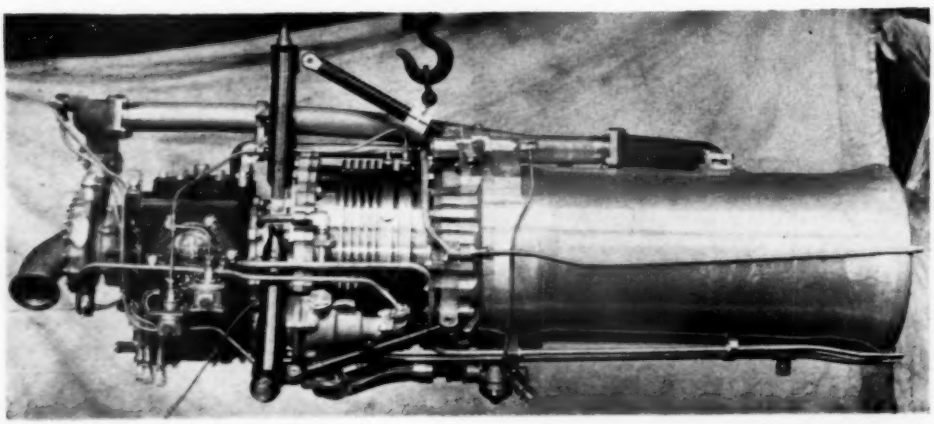
No separate starter is used, the pilot has only to initiate nitrogen pressurization of the peroxide tank so that oxidant



is pushed through the silver-plated gauze catalyst pack and creates superheated steam by decomposition. Similarly, the same 15-p.s.i. nitrogen pressure primes the fuel pump so that when both propellent pumps are driven via a turbine, by the flow of oxidant, fuel is delivered to the combustion chamber.

Electric pressure switches are fitted and it would appear that they are used for obtaining the correct phasing of operations to ensure safety of the jettisoning procedure. There is now no need for an accessories gearbox on the top of the engine.

It is intended that all Vulcans and Victors shall be able to use Spectre rocket pods and the unit is now in production. Dropping trials have been completed from a Bristol Brigand and trial installation on a Victor is to be made soon. One reason for using this extra power at take-off is that more fuel or a heavier weapon can thereby be carried. Alternatively, the extra power could be used to permit operation from high-level airfields in high ambient temperatures. It would seem likely that this use of Spectres will be of assistance to our latest V-bombers in taking-off within the standard Bomber Command runway length when carrying the stand-off bomb. It is more than likely that V-bomber rocket-boosting will provide as well as steal some of the thunder at the next S.B.A.C. Show.—D.G.



V-BOMBER BOOST.—Assisted take-off power for the Vulcan and Victor is provided by two jettisonable pods, each containing a D.H. Spectre bi-propellent rocket engine. The fixed-thrust Spectre used, left, has considerably simpler accessories than the variable-thrust version. The pod, above, has small foreplanes to assist "clean" separation on release, which is shown in the picture at the top of the page.

How to Produce More Lightplanes

EDGAR PERCIVAL, F.R.Ae.S., M.S.A.E., M.I.Ae.E., A.F.I.A.S., M.I.Mar.E., F.R.S.A.,
replies to Fred Dunkerley.

THE matter of providing light aircraft of the "executive" type and for the private owner in this country, as discussed at the recent Royal Aero Club House Dinner (see THE AEROPLANE for January 31, p. 156), is one that has exercised my mind on many occasions over the past several years. It is a matter that hinges almost entirely upon finance. In order to produce such aircraft at a suitable selling price, there must exist the ready demand to justify a production programme of adequate proportions, and almost essentially a reasonable part of that ready demand should be of local origin in the United Kingdom. That would be the ideal state such as obtains in the United States for the American manufacturers.

In addition to this natural local demand, the U.S. manufacturer has an added advantage in that practically every manufacturer of light aircraft has received at some time a sizeable order from either the U.S. Air Force, the Army, or the Navy. These orders sometimes amount to as many as 150 aircraft or more at a time, and it is needless to point out what beneficial effect this has upon amortization of tooling and development costs.

In considering whether or not the production of small aircraft is a commercially feasible proposition in the U.K. several factors must be considered; first, of course, finance. I should like to say at this point it is unfortunate that one or another of the larger concerns or groups in the aircraft industry here do not see their way clear to include such an undertaking in their programme, particularly in the present state of the industry. I fully appreciate that companies are obliged to consider their shareholders and, therefore, are precluded from entering into any undertaking unless it is almost certain to show a handsome return on the investment. But it must be remembered that these firms have led a very sheltered life for a great many years, with practically guaranteed profits, and I feel they owe it to the nation to "cast some bread upon the waters," however foreign it may seem in comparison with the past.

They already have the facilities and their finances should allow them to allocate the relatively small sum required. If the financial requirements cannot be satisfied in this manner, it is difficult to visualize from what source the funds can be obtained. The usual finance house or finance group, where a relatively quick return is the usual aim, would be unsuitable, as has so often been proved in the past.

The "usability" of the small aircraft is, naturally, a big factor in the potential sales. This applies to all countries, but particularly to the U.K. The usability is closely linked with suitable airports or landing grounds adjacent to towns and industrial areas. The user of small aircraft is not usually well placed as regards organized transport from airfields to towns, except perhaps at his home base. London is particularly badly served in respect of suitable airfields, and according to reports some of those now existing will soon be unavailable. If we look at the history of such airfields since the last War, we see a sorry picture indeed and one that must be taken as indicative of the attitude in official circles. It is essential that small aircraft are allowed to make use of more airfields, both civil and Service, than they are at present. Other countries encourage this; why cannot we?

In considering the official attitude to the small aircraft, it is interesting to study what takes place at a busy American airport. Chicago, recognized as the World's busiest airport, has risen to new heights as to activity. There were 408,059 aircraft movements in 1957. This averages over 46 aircraft movements per hour for 24 hours per day for 365 days in the year. This is over three times the number of movements at London Airport. Small aircraft are allowed to use Chicago Airport and safety figures do not seem to have suffered in the least. As a further indication of our official attitude, I am told on good authority that British delegates to ICAO continually advocate for extreme, rigid control on all flying throughout the World, to match the strict regulations obtaining in the U.K. and their excuse is "for safety reasons." This attitude is largely why there is so little use of the small aircraft in this country.

So far as powerplant is concerned, we have no engine or choice of engines of the right kind in this country, and the longer this state of affairs is allowed to exist the less chance there is of rectification. I feel there should be a relaxation of currency regulations for a period of, say, four or five years, to enable any firm with sufficient courage to enter into a programme of building small aircraft to import their engines from the U.S. The total dollars required would be quite small in relation to the benefits accruing to the future of this section of the industry, and would help to build up an export market. At some later point, the engines could be built in the U.K. under licence, or possibly a suitable design would be forthcoming.

Whether or not such an aircraft should be single- or twin-engined is governed by cost. Probably the majority of prospective owners would prefer a twin, but are not always prepared to pay the extra price involved. From the first cost and the operating cost point of view, there would be a wider sale for the single-engined aircraft, but for "executive" use the twin would be more in demand. In that case, to cover the market reasonably well, both a single and a twin should be produced. This, of course, would almost certainly involve engines of two different powers, which, again, would reduce the number of engines required in each power, and would increase the cost, unless a large number of the engine parts were common to each of the powers chosen. In view of this, it would be necessary to import the engines from the U.S.,

LIGHTPLANE PRODUCTION MUSTS

- *FINANCE*
- *REDUCTION OF OFFICIAL HOSTILITY*
- *MAIN AIRPORTS TO BE AVAILABLE*
- *IMPORTATION OF ENGINES*
- *METAL CONSTRUCTION*
- *DESIGN REQUIREMENTS TO A.P.1208*
- *GOVERNMENT RECOGNITION*

where they are available in a variety of powers in quantity production, until assured demand justifies local manufacture.

Although several manufacturers on the Continent offer aircraft built of wood—indeed, one well-known firm in the U.S. offers an aircraft in this material—and although an aircraft in wood could be sold a good deal cheaper, I have no doubt in my own mind that all-metal contruction should be used, particularly as the export market would be the main aim. Jigs and tools for an all-metal aircraft are costly, and sizeable production must be envisaged if the price of the aircraft is to be right.

Relaxing Requirements

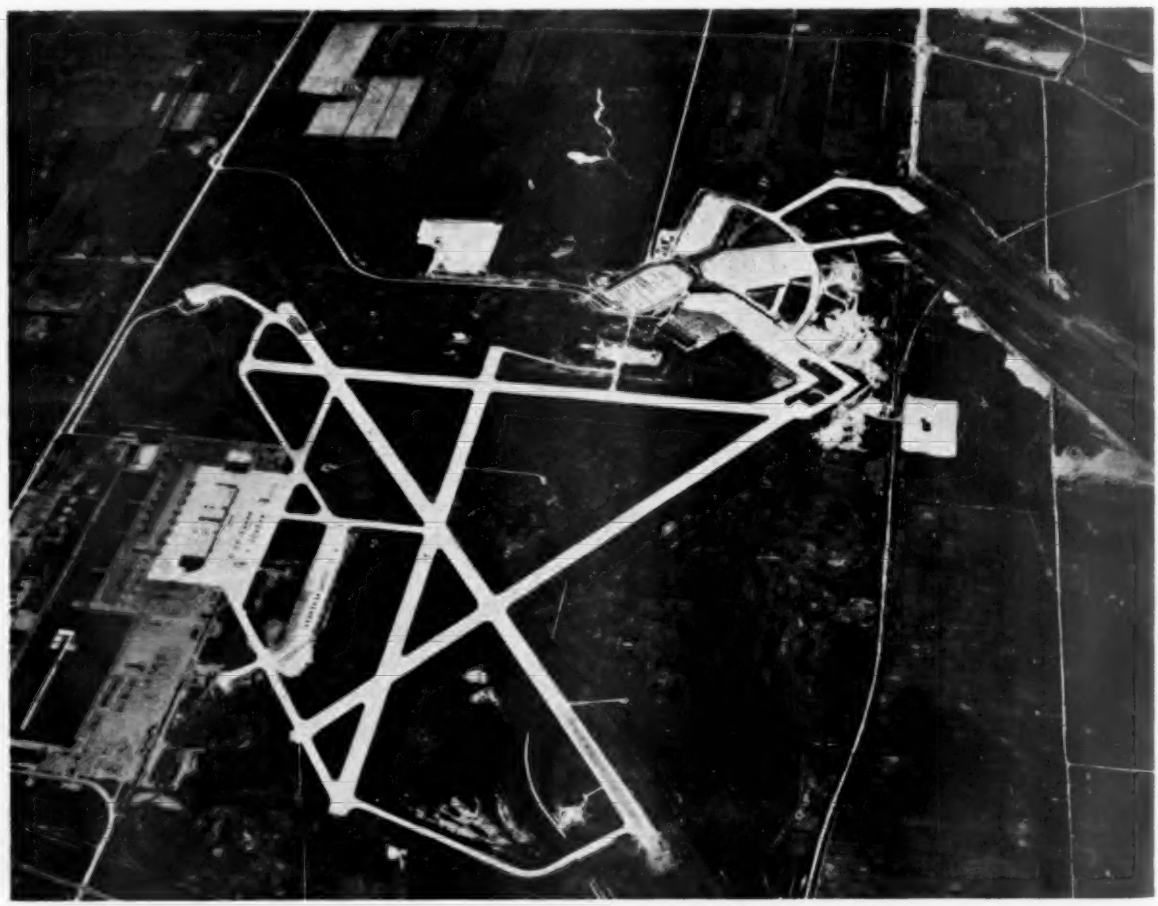
A contribution toward the cost of design and of obtaining the type Certificate of Airworthiness, would be a slight relaxation of the present requirements. I would strongly advocate this relaxation to apply to all aircraft with a gross weight of up to about five or six thousand pounds. Perhaps we could be allowed to design to A.P.1208. Many fine aircraft were built to these requirements and did a great many years of hard service under all conditions. I may be able to name some if I were pressed. The small aircraft pays a heavy penalty under the present design requirements, as compared with the airliner. The American small aircraft are built to something equivalent to the A.P.1208, and I see no reason why it should not be allowed here.

I consider that the manufacture of some small types of aircraft in the United Kingdom is essential. We must provide them to help our export trade, not only throughout the Commonwealth, where we usually enjoy a preferential tariff, but for export to other soft-currency areas. We have the skill, and we have now practically unlimited manufacturing capacity, due to reductions in Service requirements. The manufacturing programme would not employ a vast number of people, but it would be nothing short of a disgrace if we did not employ every possible man in building aircraft whose skill has been built up over many years. We must not allow that skill to wither.

American small aircraft of one kind and another are being sold in sizeable quantities in a great many markets throughout the World, where we should be predominant. If not only in the interests of our export market, we should consider international prestige. If we are expecting to sell our airliners in various countries, the small aircraft could be a constant reminder of British skill in many places. Furthermore, manufacturing such aircraft would help to keep alive, and indeed help to train, more skilled people for the expanding business in airliners, which we all hope will materialize.

For all these reasons, the building of small aircraft should receive some form of Government recognition or support, until the business becomes mainly self-supporting. It is supported in a most practical manner in other countries, as I have stated earlier, and can be done in such a way that the State receives full value for money spent. In France, the Army bought 425 Max Holste Broussards, and the German Government has placed an order for over 400 Dornier Do 27s. Both of these aircraft are in the small "executive" and private-owner class and have proved to be of great use to their owners. In the national interest, the S.B.A.C. will have to play its part and take a wider view than they have in the past.

This section of industry can revive, and we should see that it does revive. It will take courage and some money, but it can be done, but only if the obstacles referred to earlier are removed. If we do not take this opportunity, we discard a national heritage.



When O'Hare Field, Chicago's international airport, is completed it will be one of the largest in the World, covering 6,325 acres. The first of what are to be five Y-shaped fingers with 16 "gates" can be seen at the top right. Capt. Percival gives figures to show how large a proportion of the total aircraft movements in and out of Chicago is done by privately owned aircraft.

PRIVATE FLYING

H.J.C.'s Club Commentary:

Indian Subsidies

News from Gloucester— —and from Coventry

● SUBSTANTIAL SUBSIDIES from the Government are the happy lot of flying clubs in India, according to *Air Age*, which is described as the official organ of the Helicopter Association of India. These grants are dependent on the number of hours flown each year, and the clubs are divided into four classes by the Director-General of Civil Aviation.

Class I—Clubs flying more than 3,500 hr. a year;

Class II—Clubs flying more than 2,500 hr. a year;

Class III—Clubs flying more than 1,500 hr. a year; and

Class IV—Clubs flying more than 1,000 hr. a year.

At present the only club in India falling within the first category is the **Bombay Flying Club,** which was founded in 1928 at Juhu airport. Since its small beginnings it has grown into a large and flourishing organization which has trained a large number of pilots, many of whom now occupy high positions in Air India International and various Government organizations.

Training, which is normally given on Piper Super Cubs, includes instruction up to P.P.L. standard; for N.C.C. Air Wing cadets, and for the Bombay Home Guards Air Wing. Members pay an entry fee of Rs.500 (*sic*) and an annual subscription of Rs.60. A flying rate of Rs.10 (about 14s. 6d.) an hour is charged to members under 28 years of age; those above this age pay Rs.25 (36s.).

During the last financial year the club received Rs.249,197 subsidy from the Government of India and Rs.150,560 from the Government of Bombay, for a total of 4,530 flying hours.

A COVENTRY GROUP.—Members of the A.S. Flying Club with their Tipsy monoplane. Below the propeller boss is the C.F.I., Harold Ashworth; on his left, in front, is John Hill, assistant instructor; next is Stan Clarke, social secretary; then Beverley Adams, chairman, Jim Hilton and Reg. Cleaver (ground engineers) and Basil Fryer. The secretary, Frank Hudson, is on the extreme left of the front row.

● ONE OF the clubs responding to our request for news of activities is the **Cheltenham Aero Club.** This unit flies from Staverton aerodrome and the club secretary and C.F.I. is Mr. Aubrey Reeves.

Aircraft operated by the club, and the hourly flying rates, are an Aiglet Trainer (£4 4s.), an Autocrat (£3 5s.), and a Messenger (£4 10s.). Schemes for increasing the use of the aircraft are under way, which should result in reduced flying rates. Servicing is done by the club's own engineer, Mr. Ron Taylor, and it will soon be possible to undertake maintenance work on aircraft other than the club's.

The bar and lounge have been completely rebuilt and redecorated by members and the catering accommodation has been improved. A new building, to house the Link trainer and lecture rooms, is soon to be put up behind the existing buildings, so centralizing operations. The club will shortly introduce a social membership scheme, provision for which was made in the original constitution.

The C.F.I. has undertaken to produce an instructor's handbook on the lines of A.P.3225, but more specifically for civil training requirements. It is being written in consultation with the R.A.F. Central Flying School so that the latest practices are incorporated.

● A MEMBER of the **A.S. Flying Club,** at Baginton, Coventry, Mr. Ted Wurr, has recently flown solo after four hours' instruction; also to achieve an early solo is Mr. Don Craven, who did so after 5 hr. The youngest member, Miss Diana Hill, aged 17, has also flown solo—after 8¼ hr. Miss Ruth Sully, 19, who edits the club's newsletter, has just gained her licence. Other members who were approaching the P.P.L. stage at the time of writing were Jim Hilton and Reg. Cleaver, and about 30 members are between the solo and P.P.L. stages.

The club evidently puts its Tipsy, G-AFSC, to very good use, for it flies at most week-ends from about 09.00 hrs. for as long as the light lasts.

An American Trend

WHILE amateur builders in Britain concentrate on lightweight monoplanes, the biplane has by no means been overlooked in the U.S.A., and several examples are flying or being developed. One of them is this SA-100 Starduster built by Messrs. Stolp and Adams, of Compton, California. It took 22 months of spare time to produce. At the time of writing it had only undergone high-speed taxi-ing runs and had lifted off the ground about 10 ft.

The Starduster has a metal forward section and the aft section is fabric-covered; it is powered by a 100-h.p. Lycoming flat-four engine driving a two-blade fixed-pitch propeller. The wing span is 19 ft. and the upper plane is swept back 12 in. The aircraft is 16 ft. long with a height of 6 ft. 1 in. Empty, it weighs 699 lb. and loaded 1,080 lb.

Levy-Enich photograph

GLIDING NOTES

"ALREADY there is talk of forming a gliding club, and permission to use the Itford-Firle ridge has been obtained from the owners of the land." So wrote the *Manchester Guardian* on October 23, 1922, after the conclusion of the first British soaring contest. Thirty-three years later, the Southdown Gliding Club adopted Firle as its permanent home, after making occasional expeditions there from its previous site on the coast at Friston. Apart from that, the only other soaring done on the ridge since the 1922 meeting was in 1930.

The chief sign of permanent occupation is an excellent hangar, æsthetically placed below the skyline to southward, and on January 25 it made a useful occasional shelter from the biting wind and the slushy snow—a very different scene from that of picnicking crowds at the early meetings. In a south wind the club Olympia managed to maintain height occasionally over the gentle southerly slopes, which those crude 1922 gliders could never have done; fortunately they did not have to try, for the wind stayed northerly throughout their meeting.

The only other building on the hilltop is a tin hut which it is hoped to extend fore and aft to make a clubhouse and dormitory. At present a cottage at the bottom of the north face, by Bo-Peep Farm, serves both purposes.

That quotation from the *Manchester Guardian* ended with another piece of prophecy: "The continued popularity of the sport will depend upon the progress made in the power to travel across country by means of a succession of rising air currents." And this, though they did not know it, could have served the members as a text for a lively discussion which took up much of the annual general meeting next day, January 26.

* * *

The club fleet consists of a T-21b two-seater, an Olympia, two Tutors and the wherewithal to assemble a Cadet. What should be the next addition when the club can afford one? The chairman, Mr. Mornington Glasborow ("Morn" to his fellow-members) was in favour of another two-seater for training—preferably a T-31 (two-seat Tutor), as a second T-21b would be too much for a small club to handle. On the other hand, the chief instructor, Brian Buckley, who has held the post for eight months and flies for Eagle Airways when not gliding, was in favour of a high-performance machine such as a Skylark 3 or Olympia 4; but the president, John Furlong, reminded the club that these, too, would need extra handling, and that high performance has to be paid for.

One of Buckley's arguments was that proximity to the sea reduces the number of good thermal days, and performance must be stepped up to compensate. Besides, the best distance flights from the club are made by slope-soaring westwards along the South Downs, and a good gliding angle at high speed is often needed to cross the gaps. Actually, in April last year, Buckley soared all along the Downs in the Olympia without thermal help, but a N.N.E. wind gave him a small favourable wind component.

But what really sustained the argument for so long was many people's awareness of an idea that is beginning to be fostered by a few people well up in the gliding world—a proposition that the smaller clubs should concentrate on elementary training, and send their members on to some larger centre for advanced work. This may appear sound from a business point of view, but it neglects the "imponderables," for, as Buckley pointed out, a volunteer instructor likes to be rewarded for his trouble by watching his better pupils progress till they have become first-class pilots. In fact, one purpose of a large entrance fee to a gliding club is to keep out the half-hearted member who disappears in a few weeks, leaving the instructors with a feeling of frustration at having given devoted service for nothing.

The notion that a pupil should be pushed off among the lions elsewhere just as he is getting interesting, to make room for another starter, reminds one of the well-known monologue about the poor mother who lost her Albert to the lions at the zoo. When the keeper tried to cheer her up by hoping she would soon produce another family as replacement, the indignant woman replied: "What, spend all my life rearin' children to feed ruddy lions? Not me!"

Southdown Gliding Club now has 135 members, the flying membership having increased and associates decreased. Flying time for 1957 was 316 hr. 56 min., a slight decrease on 1956. Launches, numbering 2,836, were up by over 300. And 1958 sees a bold change of policy: a full-time ground engineer has been taken on in the person of Peter Staff, who has been gliding with the R.A.F. in Germany for many years and spent his first fortnight as a civilian brushing up his technique at Slingsby's. For the lack of him, parts of the club fleet were out of action unnecessarily long last year; now, it is hoped, he will be able to help club finances by taking on outside work too.

An original "system of costing" has been evolved by the treasurer, Joan Cloke, the only committee member to hold her job down for three years. It is: launching fees should pay for fuel and maintenance of transport and equipment, soaring fees for maintenance of aircraft, annual subscriptions for overheads and loan repayments (to Kemsley Flying Trust), and camping fees for miscellaneous items such as light and heat.

* * *

A NEW French altitude record for single-seaters was set up at St. Auban, the famous wave-soaring centre, in the course of an 8-hr. flight on January 19, Walt H. Pratt writes. The pilot, M. Barbera, reached 9,670 m. (31,726 ft.), beating the previous record by about 400 m. Earlier in the month M. Landi reached 8,300 m. (27,231 ft.) at St. Auban after a climb of 7,300 m. (23,950 ft.), and Mlle. Dupuy du Méry climbed to the same height, thereby becoming the third woman pilot in France to add all three diamonds to her Gold "C." Among others who exceeded 7,000 m. were some German visitors.

This year's research work on waves at St. Auban is not only being supported by S.F.A.S.A., the sporting aviation organization, but the National Defence Scientific Department is co-operating. The expedition will be led by M. Gerbier, who was chief meteorologist at the last World Championships, and M. Landi will be chief pilot.

* * *

ON January 19, the day the French were getting exceptionally good waves at St. Auban, the Midland Gliding Club were soaring in winter thermals over the Long Mynd—in fact, John Hickling writes, they "would have seemed good even on a summer day." They were smooth and wide, and pilots were reporting 20 ft./sec. lift in places. Snow showers had to be dodged, but cloud base at 4,300 ft. a.s.l. was easily reached. The Olympia 403 took part, with David Ince and Harry Midwood.

The weather chart shows a cold front lying across Northern France, with St. Auban near the tip of the preceding warm front. The Long Mynd, on the other hand, lay in a wind stream coming directly at high speed from Franz Josef Land in latitude 81° N., via Spitzbergen; only on passing Scotland did it change from a N.N.E. to a N.W. wind and slow down somewhat.

As usual, the Midland Gliding Club is holding an inter-club rally at Easter. This time the contest will begin on Good Friday, April 4, instead of that being a practice day, and will include Tuesday, April 8. However, there will be only four competition days for each pilot, and competitors will have to declare beforehand whether they will compete from Friday to Monday inclusive, or from Saturday to Tuesday.

* * *

NO FEWER than 13 clubs are holding instruction courses, open to outsiders, this year. They range in latitude from Aberdeen to the Isle of Wight and Perranporth. We cannot list all the dates and prices here, but these can be obtained from the B.G.A., 19 Park Lane, London, W.1.—A. E. SLATER.

AIRLINE GLIDING.—Three Spatz sailplanes lined up at Aigen gliding school in Austria during the visit there of a party from the B.E.A. Gliding Club.

The Latest in VTOL

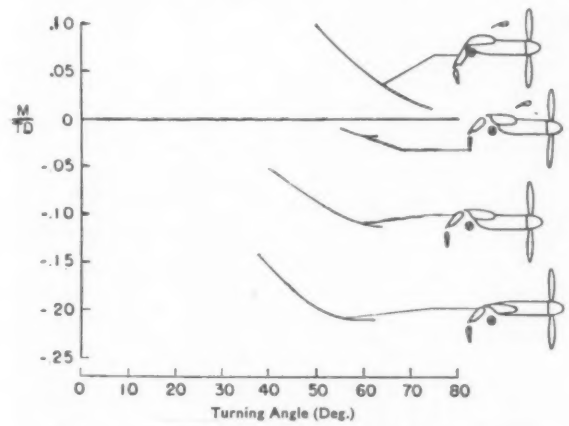
SEVERAL new projects for VTOL aircraft have been announced in America for Bell, Fairchild and the Robertson Aircraft Corpn. It is reported that the Bell Aircraft Corpn. is developing a VTOL fighter for the U.S. Navy and that the U.S.A.F. is sufficiently interested in the project to provide some financial backing. Fairchild has projected a research type for the U.S. Army.

Since Bell has produced two VTOL research aircraft of the flat-riser type—the latest is the X-14 powered by two Armstrong Siddeley Vipers—the new interceptor is presumably of this type.

The Ryan company has been successful in producing the Rolls-Royce Avon-powered X-14 Vertijet tail-sitter, but no production order has been announced for an interceptor based on that design. This may indicate that, although Ryan has solved the problem of transition from vertical to horizontal attitude, there is an official preference for an aircraft which has its wing at zero angle of attack (flat-riser) rather than making a 90°-transition swing "through the stall" (tail-sitter) while gaining forward speed at the same time.

Both types of aircraft need an autostabilization system during vertical flight, but the flat-riser has the advantage of being at the normal flight attitude at all times, which eliminates one variable from the system and thereby obviously contributes to safety. The only case for a tail-sitter ("VTOL—The Ways and Means," THE AEROPLANE, December 13, 1957) is when the normal thrust requirement approaches the order of the gross weight, as is the case with an interceptor. But if equal performance can be achieved with a flat-riser by deflecting the jet downward, or by driving ducted fans with the efflux, then this solution is to be preferred.

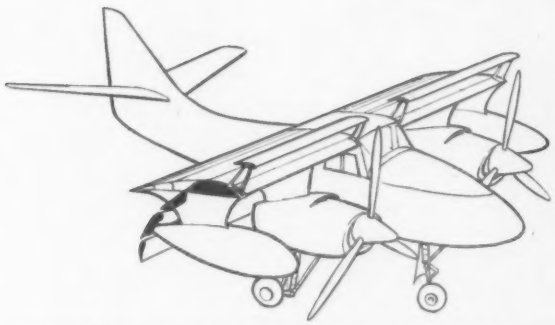
The latest scheme from the prolific project team of Fairchild is for a deflected-slipstream flat-riser research aircraft for the U.S. Army. Power to four propellers is from a single engine—probably a Lycoming T53 as fitted to the Ryan Vertiplane and Vertol Model 76 VTOL types—mounted in the fuselage, and the aircraft is a single-seater with open cockpit.



RELATIVE MERITS.—These NACA results show the effect of flap configuration on pitching moments. The top curve shows the obvious merits of the sliding flap/slotted flap/slat layout.

An odd feature is the provision of a small four-bladed rotor aft of the T-tail which is characteristic of most deflected-slipstream aircraft. The reason for this means of additional control in pitch is not far to seek because the deflected-slipstream aircraft has large nose-down pitching moment when hovering with flaps down, and the small tail rotor—shaft-driven from the engine as in the case of a helicopter—is a simple if inelegant means of combating this.

Very soon after the project had been announced by the Robertson Aircraft Corpn., tethered flight trials of the company's deflected-slipstream type took place. This remarkably quick progress was achieved by use of a standard Aero Commander fuselage and tail unit to which a new wing and power-plant system had been added. The Robertson company is a research-and-development subsidiary of the Aero Design and Engineering Co., makers of the Aero Commander executive aeroplane.



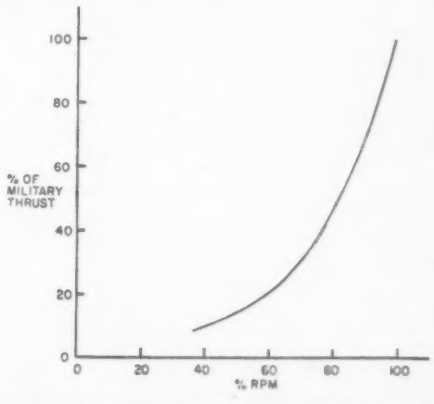
VECTORED LIFTER.—Now undergoing flight trials, the Robertson VTOL aeroplane has the NACA system of sliding flaps and slotted flaps, with leading-edge slats for longitudinal stability in hovering flight. The flap system is shown in the diagram below.

The Robertson VTOL aircraft is the best-looking deflected-slipstream flat-riser so far, due both to use of the sleek Aero Commander fuselage and also to the neat treatment of the new wing and its appendages. The two 340-b.h.p. Lycoming GSO-480 engines are mounted on stalks under the wings and the endplate fairings at the wing tips are combined with fuel tanks.

Triple flaps are lowered from the wing for VTOL flight and are used in conjunction with slats raised above the leading edge. These slats give good trim control and were developed by the NACA for use in hovering flight and during transition from vertical to forward flight.

With a multiple-flap system, large diving-moments are developed when the slipstream of the propellers is turned through a large angle. This nose-down pitching moment can be reduced by lowering the axes of the propeller shafts, and this explains the stalk-mounted engines of the Robertson design, but if this is overdone there are excessive losses in air deflection angle.

The use of a large slat well above the leading edge of the wing also reduces the diving moment, and a third means of reducing it is the use of a flap system of which the foremost section is of sliding-flap type. It appears that all three palliatives have been employed on this interesting aircraft. Conventional controls are used and if the design proves to be successful, this aircraft will be the most stylish and least complicated of its type yet to appear.—D.G.



CAUTION NEEDED.—Variation of turbojet static thrust with engine speed shows the need for a vernier throttle control in a jet-powered VTOL aircraft because of the steep curve-slope as take-off thrust is approached.

Thoughts After a Debate

DURING the past year or two the annual civil aviation debate in the Commons, based on the reports of the two airline Corporations, has tended to become, so far as its main subject-matter is concerned, something of a mutual congratulation discussion in which all concerned, including the independent operators, are slapped jovially on the back.

In one way this is a very good sign—since it shows that each side of the House is becoming more disinterestedly concerned with the progress of British air transport as a whole. But it would be rather more to the point if, in this worthy state of mind, the Government and the Opposition could come to some firm and happy agreement about the best long-term structure for ensuring the future of the business.

The general air of this annual debate (on January 27)—which is carried on in the manner of a lot of proud foster-parents—may have seemed, again, to be a happy one, but one or two stern remarks from Opposition members made it clear that the time is not, unfortunately, quite ripe for a real truce in the civil aviation battle.

One of these remarks based on comments in B.E.A.'s report, suggested that the independents' inclusive tour business was eroding the Coporation's business away. The answers given to this charge were that B.E.A. had given no figures of the diversion of traffic involved, so the correctness of that statement could be neither proved nor disproved, and that the Corporation's business had nevertheless increased by a very marked amount, so that there was obviously plenty of traffic for everyone.

Another series of comments, by MR. IAN MIKARDO (Lab., Reading) were in the form of recommendations for ending this civil war by a tightening-up of the monopoly screw—so there is obviously not much chance yet of a satisfactory settlement. Mr. Mikardo said that the restrictions on the carrying of troops and freight by the Corporations, and of the operation of Colonial Coach services, should be removed; that "public support" should be withdrawn from those private companies which have shown themselves unwilling to work amicably with the Corporations and which have "mistaken buccaneering for enterprise;" that joint arrangements between the companies should be encouraged; and that the monopoly of scheduled services should be restored to the Corporations. All of which would put us back just where we were before 1952.

For the rest of the subject matter of the debate, almost the only signs of mild acrimony—from both sides of the House—were concerned with the B.E.A. turbojet order and with the evils of "shotgun marriages" (or "gunshot marriages" as one Member insisted on calling them). Both Conservative and Labour speakers showed concern about the Government's attitude in this affair and questioned, in effect, the right of Ministries to intervene in business matters. MR. G. R. STRAUSS (Lab., Vauxhall), for instance, pointed out that, since both contending parties for the B.E.A. contract presumably considered that they had ample resources to undertake the work involved, it was curious that the Government should appear to know better. LORD BALNEIL (Con., Hertford) was concerned that nobody had been told what really lay at the bottom of the dispute and suggested that the Government was trying "to call the tune without paying the piper."

Dealing with the more general problems for the aircraft industry, Members on both sides of the House said that no cuts in development and research expenditure should be made and SIR ARTHUR VERE HARVEY (Con., Macclesfield) recommended the setting up of an independent Air Policy Tribunal. He was also concerned that so little was being done in investigations into the problems of supersonic aircraft, and said that the industry should be taken more into the confidence of the Government and be told in detail what was likely to be wanted from them in the future.

The debate produced one or two rather amusing little pin-pricks for the planners. It appears that a mistake was made in the Gatwick building and that the double-track diversion road bottlenecks there into a single track where it passes under the building. This error is being rectified; luckily there is room to do so between the pillars which hold the overpass. The Queen's Building in L.A.P.'s central area was described by Mr. Mikardo as one of the most inefficient institutions for its purpose which he had ever come across. Intricate work, as he put it, has to be done in parts of the building where there is no access to the outside and where there is no natural light and no ventilation. The Ministry now has to "rip out walls and rip up floors" in order to install an air-conditioning system—which was obviously necessary from the start. Well, well—we all make mistakes.—H.A.T.

News Items from the Debate

Three methods of speeding-up transport from central London to London Airport are now being discussed:

1, A new road (probably a double-decker, so as to reduce the amount of housing demolition necessary) between the Chiswick fly-over and the airport; 2, a monorail on high tracks, using cars having the ability to complete the journey as buses from the railhead to the central area; and 3, a normal rail link, which might, however, cost as much as £20 million because of the need to drive a new tunnel to the central area.

* * *

Municipalities are to be encouraged to own and operate airports. Discussions to this end are proceeding between M.T.C.A. and the authorities at Birmingham, Southampton and Liverpool.

* * *

New runway, or runway-extension, plans are being considered for Prestwick—which continues to be considered by the Government as Britain's "second international airport."

* * *

B.O.A.C. is to make the first move in restoring its South American operations in the autumn of 1958—when services to and from Carácas, Venezuela, will be started.

* * *

For England, Scotland and, probably, Northern Ireland, there will be restrictions in the future on the construction of buildings within an area near the last 4,500 ft. of the approaches to the main runways of certain busy civil airports.

* * *

The Ministry of Transport and Civil Aviation will investigate the noise levels of each of the future turbojet transports before these aircraft will be permitted to use the Ministry's major airports.

Quotations out of Context

"I should like to see more municipalities going into the airport business and my department getting out of it, because it is not really our business."

"I do not think that there is now any aircraft manufacturer who has not had a chance of associating himself with this [the B.E.A.] order if he wants to. . . . There is no compulsion. . . ." (Mr. Harold Watkinson.)

* * *

"It would appear that the Government are trying to call the tune without paying the piper." (Lord Balneil.)

* * *

"I would remind the House that Wales is the only country in Europe this side of the Iron Curtain which is not served by the Corporation [B.E.A.]." (Mr. Cledwyn Hughes.)

* * *

"In civil and military aviation the Ministry of Supply has been for years the biggest barnacle on the keel of efficiency that ever was." (Mr. Farey-Jones.)

* * *

"There cannot be good publicity about bad things or bad publicity about good things." (Mr. Ian Mikardo.)

* * *

"Tourist fares will be increased so that the differential between the new economy fare and the tourist fare will be 20%." (Mr. Airey Neave.)

CORRESPONDENCE

From Major The Hon. Sherman Stonor, D.L., J.P.

Not Weather-worthy

IN your sad article of January 24 concerning the end of R.A.F. Biggin Hill as an operational station, you refer to No. 141 Squadron as being equipped with Gloster Javelin all-weather fighters. I am tempted to ask the meaning of an "all-weather fighter" because you go on to say that owing to the weather the Javelins were unable to get to Biggin Hill on this occasion. I assume in fact that the aircraft of No. 41 Squadron could have flown to Biggin but that the risk was thought unacceptable for a purpose which was not operational.

Henley-on-Thames. SHERMAN STONOR.

Aiding the Private Flyer

A LONDON evening paper reports that after an inquiry with reference to noise, "the *Housing* Minister is allowing Mr. Robert Jones to continue the use of his private airstrip in the grounds of his home, Stilemans, Munstead Heath, near Godalming, as a take-off and landing ground for his light aircraft."

It is certainly very refreshing to see one of Her Majesty's Ministers of the Crown *supporting* private flying—even if it is not the one whose bounden duty it is to do so!

Croydon Airport, Surrey. C. NEPEAN BISHOP.

[Reference to the M.T.C.A. and the Ministry of Housing and Local Government has elicited the following information:—

A private pilot may put down in any field in the United Kingdom so long as he has the permission of the owner. In this case the pilot is the owner, but he would have to obtain planning permission if he wanted to develop the land or put it to a use different from that originally intended. In Mr. Jones's case the local R.D.C., acting on behalf of the county council, refused permission because a shed for housing farm machinery and a light aircraft was being put up on the land, and because the land was to be used for aircraft take-offs and landings. Mr. Jones had the right to take the matter to the Minister of Housing and Local Government, and he successfully appealed against the local council's decision.—ED.]

Where are the Light Aircraft of Yesteryear?

FOR some months past I have been following with much interest the progress with French-designed ultra-light aircraft, especially those being constructed in this country. Those concerned with these aircraft tend to exhibit considerable enthusiasm for their general capabilities. One particular type of aeroplane is earmarked for production, at what seems to be a fabulous price. This machine offers nothing extra over the well-liked Chipmunk; indeed, in my opinion, it is downright ugly. Perhaps the old school is dying; "if it looks right it flies right" used to be the motto.

In the much-to-be-hoped-for event of club flying regaining its pre-War popularity, a potential market for approximately 400-500 light aircraft would exist. Once British light aircraft firms created a favourable impression at the Farnborough "Missile" Show, it would seem only logical to suppose that export orders would soon follow. Perhaps Capt. Percival can repeat his first success of his E.P.9.

A flying instructor at my old much-lamented R.F.S. summed up the present situation long before the "official axe" arrived: "This Government is killing aviation in our country."

Keresley, Coventry. L. G. COOPER.

From Maj.-Gen. H. J. Parham C.B., C.B.E., D.S.O.

Modernizing the Autogiro

HAVING once been a pilot of C.19 and C.30 Autogiros it seems to me strange that this excellent and simple "autorotative" system has not been used more, especially now that more knowledge about rotors is available. The recent arrival of the Fairey Rotodyne, which in forward flight is a pure Autogiro, reinforces my wonder. There must be a sizeable market for a cheap, easily maintained, rotor craft for many purposes (notably in agriculture). The helicopter is neither cheap nor easily maintained.

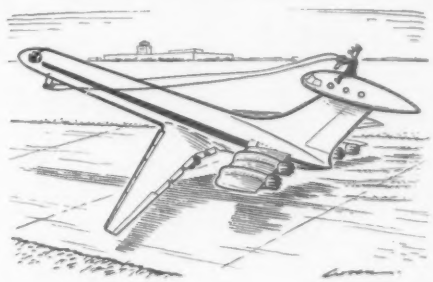
The old Autogiros handled well and landed extremely slowly. Their weakness was a relatively long take-off run, only overcome when the more complicated "jumping" C.40 came along. The reason for this long run was that, having spun up the rotor mechanically to its flying speed of 180 r.p.m., one then had to declutch it for the take-off run, during which its speed dropped some 40 r.p.m. before increasing airspeed built this up again to 180 r.p.m. when take-off occurred. Had it been possible to maintain 180 r.p.m. throughout the take-off run (which, to accelerate the craft to the modest 30 m.p.h. needed, would have been a matter of a very few yards) one would have been able to unstick extremely quickly. The C.40, of course, got its direct take-off by overspeeding a rotor whose blades had first been set to no-lift incidence.

To achieve the cheapness and simplicity of the original fixed-pitch rotor and yet get a very short (but not vertical) take-off could not a simple pressure-jet system, as demonstrated as a booster to the rotor of the Skeeter at Farnborough, be used to supplant and improve upon the engine-driven mechanical starter hitherto used on gyroplanes? Given this (which need only burn for say a minute per flight) one could retain the old simplicities of the Autogiro and yet improve its one and only serious drawback, a relatively long take-off run.

Hintlesham, Ipswich. H. J. PARHAM.

Groundabout

Rearranging the V.C.10. All sorts of comments are being made on the V.C.10's layout. One is that the engine groups could be made into a nice all-moving tailplane, replacing the commonplace job now fitted. Then there's our old friend Derek Dempster, who



edits B.O.A.C.'s *Plane Facts* and his own *Flying Saucer Review*, who would like to see the flight deck located in the "acorn" on the fin. As a pilot he has always cherished a desire to be able to see the aeroplane he's flying or, more especially, taxi-ing. After all, it's been done before, in the old hansom cab.

*

Vickerious Viewpoint. On the above tack, it is many years since airline captains saw much of their aircraft from the driving seat and now, when passengers have got used, in the Comet, to seeing engineless wings, those in the front half of the V.C.10 will be faced, like the crew, with a wingless aeroplane.

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African Digest. You've probably noticed that airline publicity never touches on crashes, not even to say, as the Australians can, "We've never had one." So East African Airways must take a poor view of a local journal's paragraph, headed "Crash Biscuits," which comforts prospective customers with the news that "crash rations," including locally produced, biscuits are carried on E.A.A.'s aircraft. However, I expect their passengers are more sensible about the facts of life than we flabby European travellers.

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Definition

Station Commander's breakfast: Two aspirins and a slow look round.

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Dirty Look

Comment by private pilot approaching industrial area: "Don't they make anything but smoke down there?"

by Gordon

NOTES AND EVENTS

AIRFIELD TENDER.—Foamite, Ltd., has developed an airfield crash fire-tender to meet the particular requirements of Westland Aircraft. Ltd. The tender is equipped with a 500 gal./min. pump, foam-making equipment, and can carry 500 gal. of water. It has a crew of six.

NEW HYDRAULIC VALVE.—The latest addition to the range of industrial hydraulic components manufactured by Dowty Hydraulic Units, Ltd., Ashchurch, is a lock valve for use with Dowty "CV"-series control valves. Available in a variety of sizes to match the control-valve range, the lock valve isolates a ram or actuator from the hydraulic system and sustains it in the position selected.

CHANGE OF ADDRESS.—Aeroservices, Ltd., has moved from Croydon Airport to new premises at East Hoathly, Lewes, Sussex. The new telephone number is Halland 393.

AGARD MEETINGS.—The third colloquium of the Combustion and Propulsion Panel of the NATO Advisory Group for Aeronautical Research and Development (AGARD) will be from March 17 to 21 in Palermo, Sicily, when the meeting will be mainly on propulsion problems. Eighteen papers on five themes will be read: Powerplant requirements related to aircraft mission; interaction of the combustion system with other engine components; noise; combustion; and aerophysical chemistry. From April 22 to 25, at Freiburg, Germany, there will be an AGARD meeting of the Wind Tunnel and Model Testing Panel on ballistics and missiles, at which 15 papers will be read and discussed.

STORM RADAR.—The Viscounts now used by Iraqi Airways are being fitted with Ekco airborne search radar.

MOND FELLOWSHIPS.—Applications are now invited for Mond Nickel Fellowships for 1958. Valued at between £900 and £1,200, they will be awarded to candidates of British nationality with a degree or equivalent qualifications. The purpose of the Fellowship is to provide successful candidates with wider experience and additional training before they take up positions in British metallurgical industries. Each Fellowship will cover one full working year. Completed application forms must be sent by June 1 to the Secretary, The Mond Nickel Fellowship Committee, 4 Grosvenor Gardens, London, S.W.1.

ELLIOTT-BENDIX CHANGES. — Elliott Bros. (London), Ltd., has closed its special department for the general sales and servicing of American-made Bendix aviation and radio equipment. In future the company will concentrate on the manufacture, under licence, of the wide range of Bendix-designed equipment, and on the sale and servicing of such units.

U.K. REPRESENTATIVE. — The Bendix Aviation Corpn. of the U.S.A. has appointed as its general sales and servicing representative Field Aviation Services, Ltd., a member of the Hunting-Clan organization.

INDUSTRIAL DESIGN. — Charles Butler Associates, the U.S. industrial design consultants, have opened a London office at 18 Cavendish Square, W.1. C.B.A. has been responsible for interior design of Viscounts for Capital, T.C.A. and Continental and of Northeast's Britannias.

COMPRESSION TERMINALS. — Hellermann, Ltd., of Crawley, has recently begun to manufacture and market a range of compression terminals and tools. Designed for use where small cables are to be installed, the compression terminals are available in a wide range of shapes and sizes in two styles. The Mark 3 hand-compression tool, used with the Hellermann terminals, produces an electrical joint of low resistance and high mechanical strength.

Aviation Calendar

February 7.—Helic. Assn. of Gt. Britain lecture, "Wind Tunnel Testing of Helicopter Models," by M. S. Hooper, F.R.Ae.S. (Fairey Aviation Co., Ltd.), in the R.Ae.S. Library, 4 Hamilton Place, **London,** W.1, at 18.00 hrs.

February 7.—A.B.A.C. Annual Dinner at the Waldorf Hotel, Aldwych, **London,** W.C.2, at 19.00 hrs. for 19.30 hrs.

February 10.—Inst. of Transport, Brancker Memorial Lecture, "The Control of Air Traffic—Origin, Development and Future Requirements," by Air Cdre. W. E. G. Mann, C.B., C.B.E., D.F.C. (M.T.C.A.), at the Jarvis Hall, Royal Inst. of British Architects, 66 Portland Place, **London,** W.1, at 17.45 hrs.

February 11.—R.Ae.S. Boscombe Down Branch, film evening, in the lecture hall, A. and A.E.E., **Boscombe Down,** at 17.45 hrs.

February 12.—Kronfeld Club lecture, "Flying and Motor Racing," by Ron Flockhart, at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

February 13.—R.Ae.S. main lecture, "The Application of the Theory of Stability in Structural Design," by H. L. Cox, F.R.Ae.S., at the Inst. of Mech. Engineers, Birdcage Walk, **London,** S.W.1, at 18.00 hrs.

February 13.—R.Ae.S. Bristol Branch lecture, "Production of Civil Aircraft," by P. Imlach (Vickers-Armstrongs, Ltd.), in the conference room, Bristol Aircraft, Ltd., Filton House, **Bristol,** at 18.00 hrs.

February 13.—R.Ae.C. film show, at 19 Park Lane, **London,** W.1, at 18.15 hrs.

February 18.—R.Ae.S. section lecture, "Aero-elastic Problems Associated with High Speeds and High Temperature," by E. G. Broadbent, A.F.R.Ae.S., in the Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

February 19.—Kronfeld Club lecture, "North Wales, the Soaring Pilot's Paradise," by Bill Crease, at 74 Eccleston Sq., **London,** S.W.1, at 20.00 hrs.

February 19.—R.Ae.S. Leicester Branch lecture, "The Activities of the P.E.R.A. Organization," by R. Tilsley, A.M.I.Mech.E., A.M.I.Prod.E. (Production Engineering Research Assn.), in the lecture theatre, **Loughborough College,** at 18.45 hrs.

February 19.—R.Ae.S. Southampton Branch. Prize Papers, in the Inst. of Education, **University of Southampton,** at 19.00 hrs.

February 19.—Inst. of Prod. Engineers, Southampton Section, lecture (in conjunction with the R.Ae.S.), "Design and Construction of an Aircraft Carrier for Naval Operation," by A. J. Sims (Director of Naval Construction, Admiralty), at **Christchurch Town Hall,** Hants, at 19.15 hrs.

Company Notices

NEW COMPANIES

Air Express, Ltd. (597,854).—Private co. Reg. Jan. 27. Cap. £1,000 in £1 shs. Objects: To carry on the business of air freight agents, etc. Directors: John E. Steward, 21 Oxford Rd., London, N.8; and David Steward, 5 Braemar Avenue, London, N.22. Sec.: J. E. Steward. Reg. off.: 8 Queen St., London, E.C.4.

Consolidated Aircraft Products, Ltd. (597,679).—Private co. Reg. Jan. 23. Cap. £5,000 in £1 shs. Objects: To carry on the business of manufacturers of and dealers in aircraft, aircraft products and accessories, etc. Subscribers (each with one sh.): Alec Litton and Clifford J. Cunnington, solicitors, both of 1 Dover St., London, W.1. First directors to be appointed by subscribers. Solrs.: Matthew, Trackman and Co., 1 Dover St., London, W.1. Reg. off.: 1 Dover St., London, W.1.

INCREASE OF CAPITAL

Z. and I. Aero Services, Ltd. (528,439), 19 Buckingham St., London, W.C.2.—Increased by £900, in £1 ordinary shs., beyond reg. cap. of £100.

New Patents

APPLICATIONS ACCEPTED

791,904.—Blackburn and General Aircraft, Ltd.—"Doors or closure members for bomb bays or like spaces in the fuselage or wings of aircraft."—March 15, 1955 (Dec. 13, 1954).

791,828.—Minister of Supply.—"Aircraft stabilizing means."—March 8, 1954 (March 6, 1953). (Addition to 742,640.)

Applications open to public inspection on March 12, 1958; opposition period expires on June 12, 1958.

792,024.—Bendix Aviation Corporation, "Altitude indicating instrument for aircraft."—Feb. 13, 1956 (Feb. 23, 1955).

792,102.—Francais, Etat.—"Apparatus for facilitating the piloting of aircraft."—Feb. 1, 1955.

Applications open to public inspection on March 19, 1958; opposition period expires on June 19, 1958.

Personal Notices

BIRTHS

Crawford.—On January 24, at Aldershot, to Gwyneth (*née* Heap), wife of Wg. Cdr. W. A. Crawford—a son.

Eden.—On January 21, at Münster, to Valerie, wife of Flt. Lt. P. C. Eden—a son.

Giles.—On January 23, at Wegberg, B.F.P.O. 40, to Peggy (*née* Ford), wife of Sqn. Ldr. D. Giles—a daughter.

Grennan.—On January 17, at Adelaide, South Australia, to Patricia Joan (*née* Tuck), wife of Flt. Lt. C. A. Grennan—a son.

Kirkpatrick.—On January 17, at Nocton Hall, to Pat (*née* Hollingsworth), wife of the late Flt. Lt. B. C. Kirkpatrick—a son.

Phillips.—On January 19, at Wegberg, B.F.P.O. 40, to Ann (*née* Gibson), wife of Sqn. Ldr. F. Phillips—a son.

Roberts.—On January 26, at Halton, to Peggy (*née* Cattell), wife of Sqn. Ldr. R. L. A. Roberts, D.F.M.—a daughter.

Wallace.—On January 21, at Douglas, I.o.M., to Jean (*née* Parsons), wife of Flt. Lt. M. W. Wallace—a son.

MARRIAGE

MacDonald—Whitehouse.—On January 25, at St. Mary's Church, Barnes, Sqn. Ldr. Neville MacDonald, to Margaret Whitehouse.

DEATHS

Johnson.—On January 24, Gp. Capt. A. F. Johnson, C.B.E., D.F.C. (retd.).

O'Malley.—On January 25, Gp. Capt. J. S. O'Malley, C.B.E., Principal Medical Officer, Air H.Q., Egypt.